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# THE FERNS OF NORTH WESTERN INDIA

C. W. HOPE



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## THE FERNS OF NORTH-WESTERN INDIA,

Including ARGHANISTAN, the TRANS-INDUS PROTECTED STATES, and KASHMIR:  
arranged and named on the basis of Hooker and Baker's *Synopsis Filicum*,  
and other works, with new Species added.

By C. W. HOPE.

(Read before the Bombay Natural History Society, on 28th of Feb., 1899.)

### PART I.—INTRODUCTORY.

THE object of this paper is to bring into one view the information regarding the ferns of the North-West Indian region which is to be found in the standard English works on ferns, and to add to that the results of my own observation and study, acquired during a long residence in India and since I left that country.

I have limited my review to the regions named in the title, because my observations and study have been chiefly so limited. Collections were made by me in parts of Kumaon in 1861, and again in 1890; in the Dehra Dun district—at various levels—at intervals from 1879 to 1895; in Simla in 1871, and again there and along the Thibet Road eastward for some 50 miles in 1886. The late Mr. H. C. Levinge began the study of ferns after seeing what I collected at Simla in 1871; and he collected diligently at Darjeeling and in other parts of Sikkim, in Bengal, and also in Kashmir and parts of the North-West Himalaya, until he left India in 1883, and he never failed to give me a share of what he got, even when I had nothing to give him in exchange. Mr. C. B. Clarke also has several times given me generous contributions of ferns collected in Sikkim, Assam, and other parts of India. And Mr. Gustav Mann, whose fame as a botanist and collector has been so often signalised by plants being named after him, has given me in exchange for North-West Indian ferns about 150 species collected by himself in Assam, where he was Conservator of Forests for many years. Since the year 1881 I have from time to time seen and examined all the ferns collected in the North-Western Himalaya, Kashmir, and the Trans-Indus Protected States by Mr. J. F. Duthie, the Director of the Botanical Department, Northern India, and his collectors, and have generally shared in the distribution made by him; and I have several times studied the ferns in the herbarium at Saharanpur, which, under Mr. Duthie's charge, have increased from one small bundle to a very considerable collection. Since the year 1880 the

ferns collected in and around Mussoorie, the hill station in the Dehra Dun district, by Mr. P. W. Mackinnon and Mr. V. A. Mackinnon of that place, have from time to time been studied by me; and during the same period extensive collections made in the Chamba and Kashmir States by Mr. J. C. McDonell, of the Imperial Forest Department, now on deputation as Conservator of Forests in Kashmir, have been at my disposal for study. I have to thank the Messrs. Mackinnon and Mr. McDonell for many fine specimens. I frequently exchanged views and specimens with the late Mr. H. F. Blanford, F.R.S., who collected for some years in the Simla region, and embodied the results of his study in a paper published in the "Journal of the Asiatic Society of Bengal" in 1888. Probably every specimen of many hundreds collected in the Punjab and Kashmir, and also in Kumaon, by Mr. E. W. Trotter, of Rawalpindi and Murree, in the years 1887 to 1892, has been scrutinised by me, and my collection has been greatly increased by his gifts. Major R. W. MacLeod, I.S.C., showed me collections made by him in Western Kashmir in 1891, and in Kumaon in 1893, and gave me many fine specimens. I have seen the collections made in the Simla region by Mr. T. Bliss, of Lahore and Simla, an enthusiastic collector and horticulturist, and I possess many fine specimens given to me by him. And, lastly, for several years before I left India, the extensive collections made by Mr. J. S. Gamble (Director of the Imperial Forest School at Dehra Dun) in the Simla region of the Punjab, the Dehra Dun district of the North-Western Provinces (which includes the Himalayan tract—Jaunsar-Bawar), the Tehri-Garhwal Hill State, Sikkim and Bhutan, in the North-Eastern Himalaya, the Chittagong and Chutia-Nagpur divisions of Bengal, and the Madras Presidency, were available; and Mr. Gamble has given me many specimens collected by him in the Dehra Dun district and Tehri-Garhwal in places which I have never been able to visit. Early in 1896, I spent some busy days in the herbarium of the Calcutta Botanic Garden, taking notes of the North-West Indian ferns there, and verifying conclusions as to the species included in this paper. I desire to record my grateful thanks to Sir George King, the late Director of the Botanical Survey of India, and to Dr. D. Prain, who has lately succeeded him, for the help they then gave me. Finally, it may be mentioned that in 1872, and again in 1888-89, I studied the



North Indian ferns in the herbarium of the Royal Gardens, Kew, where views were interchanged not only with Mr. J. G. Baker, F.R.S., but with Mr. C. B. Clarke, F.R.S., past President of the Linnean Society, and Colonel R. H. Beddome, F.L.S., the author of various works on Indian ferns. And, while preparing this paper, I unexpectedly found myself able to leave India and to settle at Kew ; and on resuming the study of ferns there—a work which was at first much hindered by ill-health—I soon found it advisable to refrain from publication until I could again carefully go through the whole material, and also that in the herbarium of the British Museum and the Wallichian Collection belonging to the Linnean Society, at both of which institutions I was made welcome. During this final period of study I have had the advantage of free access to Colonel Beddome's valuable collection, and of discussion with him as to critical plants common to both Northern and Southern India.

Following the example set by Mr. C. B. Clarke in his "Review of the Ferns of Northern India,"\* I have not attempted to make this paper a complete account of the species enumerated in it. I may say, as Mr. Clarke said of his, that my paper is meant to be an appendix to Hooker and Baker's *Synopsis Filicum* ; but it is also an appendix to Mr. Clarke's "Review," so far as the species found west of Nepal are concerned, and the remarks on the species are in part additions to, and corrective of, those works. They are also, and necessarily so, largely corrective of Colonel Beddome's "Handbook of the Ferns of British India, &c.," including the Supplement of 1892, so far as it deals with the ferns found within my limits, for his descriptions of them, and remarks, were chiefly taken from the *Synopsis Filicum* and Mr. Clarke's "Review." I have, as a rule, given no diagnoses of the species which have already been described in those works, but have merely corrected or supplemented them where it seemed necessary to do so. I have written full descriptions of the new species I propose, and also in some cases of the plants I have raised from the rank of variety to that of species.

References are given to three books only, namely, Hooker and Baker's *Synopsis Filicum*, Clarke's "Review of the Ferns of Northern India, &c.," and Beddome's "Handbook of the Ferns of British India,

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\* Transactions of the Linnean Society, 2nd Series, Botany, Vol. I (1880).

&c.," with its Supplement of 1892 ; and I have quoted the name given to each of my species in each of those works ; though in some cases I have found it difficult to identify them. As a rule, no further attempt has been made to give the synonymy of the species : that will be found sufficiently given in the books I refer to ; and as this paper is merely a supplement to these, and not a complete treatise, I see no necessity for repeating what is already in print. Mr. Clarke said in his "Review:" "No person is likely to undertake the study of Indian ferns without this book" [the *Synopsis Filicum*] "at his elbow ; and I have not wished to print more repetition than the large quantity always absolutely necessary in work of this kind." So I would say of Mr. Clarke's "Review"—though the price of the "Transactions of the Linnean Society," in which it appeared, is somewhat prohibitory. Beddome's "Handbook" also must be kept at hand and the Supplement of 1892. A third edition of the *Synopsis Filicum* is much wanted, though Mr. Baker, in 1891 and since, has contributed summaries of new ferns discovered or described since 1874 to the "Annals of Botany."

The system of classification and nomenclature followed in this paper is that of Hooker and Baker's *Synopsis Filicum*. Specific names used in the *Synopsis*, in Clarke's "Review," and in Beddome's "Handbook," with its Supplement, are adhered to so far as is possible. And in reviving some species which, though originally proposed and named by competent authorities, have been dropped by recent authors, and in raising so-called varieties to the rank of species, I have adopted the names originally given by the collectors or describers of them.

The present list admits 212 species : of these 16 are new, including 3 which have before been described by other authors as varieties of old species ; 45 are new to the regions dealt with, and 6 old species are new to the Indian region. 20 are old species revived, or so-called varieties erected into species. In his "Review" Mr. Clarke admitted 363 species of ferns, besides many varieties, in Northern India, of which 16 were new. 142 species were, he said, found in the Himalaya west of Nepal, including Afghanistan apparently.

No place is given in this list to so-called varieties, though in a few instances "forms" are noted where there seems to be a divergence

from the normal, due probably to difference of altitude or climate, but insufficient to prevent identification or to warrant separation as a species. To such "forms" separate numbers are not given. So-called varieties, when distinct enough from the so-called types to be separately described, and, so far as I know, constant as to characters, are given as species in the absence of any good reason why they should be given any less important a position. Most of these were originally named or described as good species by the collectors of them, but have afterwards been reduced by authors who have never seen them growing in their native habitats. In no such instance does there appear any evidence of origination by variation from another known species; and the place as a variety seems in most cases to have been assigned either from a fancied resemblance to an old species, or merely because the plant, being of the same genus, has been observed or discovered, and described, subsequently to the date of the description of the so-called type plant. Such plants have been ranked as varieties long enough, and, having successfully passed a period of probation, may now be promoted to specific rank. As to most of them, the difficulty seems to me—not how to distinguish them from their so-called prototypes, but—how to think and write of them as being near these. Admitting, for the sake of argument, their origin by variation, they have become good and permanent species, showing no tendency to revert, and ought to be treated as species.

In two notable instances numerous varieties of plants have been set up by authors as growing in India, the types of which are expressly stated as not having been found in that region. Thus, after giving an elaborate description of *Asplenium* (*Athyrium*) *Filix-femina*, Bernh. (*forma europæa*), apparently by himself, Mr. Clarke goes on to say that the typical form has not exactly been got in the Himalaya, and to give no less than seven varieties of it, which have been got there, with a short description of each. In this case Colonel Beddome, in his "Handbook," follows Mr. Clarke almost *verbatim*, giving all seven varieties. At least two of these, *A. Schimperii*, A. Br., and *A. pectinatum*, Wall., which have widely creeping and branching rhizomes or *sarmenta* and distantly springing fronds instead of the erect caudex and fasciculate veneration of *A. Filix-femina*, have been recognised as good species by Colonel Beddome in the Supplement to his "Handbook." In the other instance, that of *Nephrodium* (*Lastrea*) *Filix-mas*, Rich.,



Mr. Clarke wrote a diagnosis, which, he said, was "designed to include various North Indian ferns difficult to separate from the ordinary European *N. Filix-mas*, i.e., the first four varieties following"; and he then gave nearly as long diagnoses of each of these four, with figures of three of them, and diagnoses of three more varieties, with figures of them. Colonel Beddome gave in his "Handbook" a description of *N. Filix-mas* entirely different from that written by Mr. Clarke, and said the plant was found "throughout the Indian region, but generally confined to considerable elevations on the mountains"; and he then gave four varieties, in the first of which—*var. β. parallelogramma*, he combined two of Mr. Clarke's varieties and three other plants which had previously been described as species. Another of these varieties Colonel Beddome gave—*N. cochleatum*, Don.,—Mr. Clarke had given as a distinct species, hesitating to give it generic rank, though it had previously been made a new genus by two different authors. In his Supplement of 1892, Beddome says the European type of *Lastrea Filix-mas* does not occur in India! But he repeats the four varieties given in the "Handbook," including *L. cochleata* (sp.), Don, and adds six new ones, two of which—*Nephrodium subtriangulare* and *N. assamense*—are sub-tropical, low-level species, which had been described by me in the "Journal of Botany" for November, 1890, and included by Mr. Baker as described new species in his "Summary of New Ferns" published in 1891. Here, then, are in India ten varieties of a fern which itself is said not to occur in India, only two or three of which Colonel Beddome can, I think, have seen growing.

In other cases authors have not hesitated to place common North-West Indian ferns as mere varieties of species not found at all in North-West India, e.g., *Pteris stenophylla*, Hk. & Gr., Ic. Fil., t. 30, was placed by Hooker, in his *Species Filicum*, as a mere variety of *Pteris cretica*, L., and this reduction has been perpetuated by Mr. Baker. But Mr. Clarke in his "Review" altered this reduction, and placed *P. stenophylla* as a variety of *P. pellucida*, Presl.; and Colonel Beddome followed suit. *P. pellucida* has never been got in North-West India. *P. stenophylla* is wholly unlike it, and it is very plentiful in some localities round Mussoorie—exactly Hooker and Greville's plant. After long and intimate acquaintance with this fern, I have no hesitation in calling it a species.

The theory underlying all this restriction or reduction of species seems to be that recently observed plants, however apparently distinct, are likely to be mere varieties of previously known and described species. But a variety must surely be a variation proved to have originated from a known plant, and not merely a different plant which botanists think resembles a well-known plant, and, from dislike to increase the number of species, choose to call a mere variety of it.

I am well aware that there are hundreds of cultural varieties of ferns—European chiefly—and that these, having been propagated from plants found wild, retain their characters permanently when cultivated, or diverge even further from the type. But such varieties are for the most part sports, or monsters in appearance, and no one thinks of setting them up as species; and botanists do not even enumerate them under the species from which they are known or are supposed to have originated. Fern-fanciers, on the other hand, would probably cease to take an interest in them if they were recognised by botanists as species. Such sports are rarely found in India, and when met with are treated as sports not named as varieties. The so-called varieties of Indian ferns are serious entities, with no eccentricities of form or habit, and, were it not for slight or fancied resemblances in them to previously described species, there seem to be no good reasons why they also should not be favoured with full descriptions and specific names. Differences of mode of growth and venation are surely good specific distinctions; and yet we find plants so differing grouped under the same specific name, and one called a variety of the other on merely fanciful grounds. There is sometimes doubt as to the separate entity of species described in the books, because the nature of the rhizome has not been observed and described. For this collectors are of course partly to blame; but in many cases authors are silent as to the rhizome, and seem to think it a feature of no importance. An isolated plant with a woody root-stock, perhaps nearly as thick as one's wrist, of slow and almost secular growth, and which is erect, or merely decumbent, and throws up fronds from the apex in a tuft, and, if decumbent, dies off behind, while it continues to grow slowly forwards, is of a totally different nature from a fern which has a thin, perhaps succulent, quickly growing and widely-creeping and branching rhizome or *sarmentum*, which throws up fronds singly at greater or less intervals

over a large surface of ground ; and it seems impossible that the same species of fern can ever have habits so widely differing as those I have just described. I think I may challenge fern-fanciers to produce an instance of variation between such habits. It is, though there are others, mainly on this ground that Mr. E. W. Trotter and I have separated *Polypodium* (*Pheg.*), *late repens*, Trotter MS., from *P. distans*, Don, which has an erect caudex, and that I am now proposing *Nephrodium* (*Lastrea*) *repens* as a new species, distinct from *Aspidium oclithodes*, Kze. (*Nephrodium prolixum*, Baker).

Some pains have been taken to give the habitats of the species in regular order from West to East,\* and in sufficient detail to show the distribution in India ; and the distribution in other parts of the world has been carefully arranged by continents, which is not always satisfactorily done in the three works here followed and reviewed. And, except in the cases of the long recognised and common species, the authorities for the habitats or the names of collectors whose specimens have been seen and are known to have been gathered in the habitats named, have been quoted. I have not used the mark “! ” ; but it must be understood that I have either seen the specimens on which I found, or have satisfied myself, that my authority for their existence is trustworthy. This mark (!) is not used in the books I make reference to. As to the new or rarer species, the year of collection, in other cases the names of collectors—at least those of the more modern of them—are arranged, under the geographical areas, in the order of date of collection. This much seems due to those who have done so much of late years, and have helped to make the present list so full ; and in many cases it is an acknowledgment of specimens given to myself. And such full citation seems to give authority which might otherwise be thought wanting. Such an entry as—“Himalayas, ascending to 10,000 feet”—does not seem at all sufficient, or even useful. Taken literally, this would mean—“throughout the Himalaya, from west to east, and at all altitudes from the plains up to 10,000 feet” ; but in many such instances it turns out that the plant has been got only in the Eastern Himalaya, and not below (say) 5,000 feet. Again: “Himalayas, from Garhwal to Bhotan,” not only involves the assumption that the plant grows from

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\* The Hazára District of the Punjab lies to the westward of Kashmir, but is given along with the other districts of the Punjab for convenience sake.



west to east of Nepal, a country of many hundreds of miles in length that has not been open to explorers for the last 70 years or so, but it leaves in doubt in what part of Garhwal—a tract extending from the Tons to the Ramganga—the plant has been gathered. Especially in the cases of new species, or species new to India, or to the limits dealt with in this paper, does it seem proper to give full authority for statements as to habitat. Colonel Beddome, in the Supplement to his “Hand-book,” enters *Cystopteris montana*, Link., as a species new to India; but he gives “Cashmir” as the habitat, and does not give the name of the person who found it there. Until recently, when I found in the Kew Herbarium a specimen of this fern collected in Kashmir in 1877 by the late Dr. Aitchison, I was unaware of the authority for this habitat, and before I read of it I had believed that the plant had not been found in Asia, except in Kamschatka, until 1884, when it was found in Kumaun, in the North-West Himalaya, at an altitude of 12,000 to 13,000 feet, by Mr. Duthie. Other stations for the plant were discovered by Mr. Duthie over the west border of Nepal in 1886; but he never found it in Kashmir. So far as I know, no one besides Dr. Aitchison and Mr. Duthie has ever found this plant between the Carpathians in Europe and the extreme west of Asia. In the case of another entry in Beddome’s Supplement—*Asplenium germanicum*, Weiss—said to have been got in Kashmir, and therefore to be new to the Indian region—the collector’s name ought to have been stated. Mr. J. C. McDonell did find a scrap of this species in Kashmir early in 1891; but he did not know he had got it until sometime after Colonel Beddome’s Supplement had been published. As will be seen, recorded in the proper place, *A. germanicum* had been got previously in Afghanistan and Chamba.

For reasons which will be obvious, when it is considered that this paper is being published in instalments, all the new species are given first, as PART II.; and Plates of all of them will be issued along with the descriptions, or thereafter, as may be found possible. Not being a draughtsman, I am at a disadvantage in attempting to give illustrations; but Mr. N. E. Brown, the well-known botanist has carried out my ideas and wishes very correctly as well as artistically. The details and enlargements and arrangement of the Plates are entirely Mr. Brown’s; but as he could not spare time for making the finished drawings of fronds, these have been done, from his sketches and the

specimens we selected from my herbarium, in Calcutta, by Bengal artists, under the supervision of Dr. D. Prain, the Superintendent of the Royal Botanic Garden, Calcutta, who also kindly adopted the undertaking by his predecessor, Sir George King, to have the Plates lithographed for me (and the Bombay Natural History Society) in Calcutta, where, as is well known from the numerous examples in the "Annals of the Royal Botanic Garden, Calcutta," such work is very efficiently done. My very best thanks are due to Dr. Prain for having thus so materially contributed to the preparation of this paper. I am also greatly indebted to him, as well as to Sir George King and Mr. J. F. Duthie, for their help in securing the co-operation of the Bombay Natural History Society for the publication of my paper in their valuable Journal. To Mr. Duthie I must also express my grateful thanks for having passed the final proofs for the press at Bombay, which has saved many weeks of time. Additional Plates will, I hope, be given from time to time, as I may be able to get them prepared; the Society in Bombay is not wanting in liberality in that respect.

## LIST OF ABBREVIATIONS.

### BOTANICAL TERMS.

*Caud.*: caudex, from which arises the frond or stipes.

*Rhiz.*: rhizome, a creeping or climbing stem, taking the place of a caudex.

*St.*: stipes, or stipites, the stalk of the frond.

*Fr.*: Frond, or fronds, exclusive of the stipes.

*Rh.*: rhachis, the continuation of the stipes up the middle of the frond to the terminal point.

*Sec. Rh.*: secondary rhachis, or rhachises, the main branch or branches of the rhachis.

*Pinn.*: pinnæ, the primary complete divisions of a frond.

*Pinnl.*: pinnule or pinnules, the secondary complete divisions of a frond, or complete divisions of a pinna.

*Segm.*: segments, the divisions of a pinna, or of a pinnule, when more than mere teeth, lobes, or crenations.

*Ven.*: venation, the system of veins in a frond, pinna, pinnule, or segment.

*Costa*: the main vein of a group proceeding from a rhachis.

*Invol.*: involucre, the covering (cup or cap) which incloses and protects the sorus.

### MEASURES OF LENGTH.

*Ft.*: foot or feet.

*In.*: inch or inches.

*L.*: long, thus 1 in. 1., 1 ft. 1.

*W.*: wide } thus 1 in. w., or 1 in. br.  
*Br.*: broad }

5-7000': 5000 to 7000 feet altitude. 55-7000': 5500 to 7000'.

## AUTHORS' NAMES AND THEIR WORKS.

*Hook. Sp. Fil.* : Sir W. J. Hooker's *Species Filicum*.

*Syn. Fil.* : Hooker and Baker's *Synopsis Filicum*.

*C. R.* : Mr. C. B. Clarke's "Review of the Ferns of Northern India."

*Bedd. H. B.* : Colonel R. H. Beddome's "Handbook of the Ferns of British India" and Supplement.

*Wall.* : Wallich in *Catalogue of Plants*.

(Besides other abbreviations already in general use.)

## NAMES OF HABITATS.

*Afghan.* : Afghanistan.

*Trans-Ind. States* : Trans-Indus Protected States.

*Simla Reg.* : Simla Region.

*N.-W. P.* : The North-Western Provinces of the Bengal Presidency.

*(Him.)* : The Himalaya Range of Mountains.

*D. D. Dist.* : The Debra Dun District of the N.-W. Provinces.

*T. Garh.* : The Tehri Garhwal State in the N.-W. Himalaya.

*Brit. Garh.* : District of British Garhwal.

*N. Ind.* : Northern India.

*Centr. Ind.* : Central India.

*Centr. Prov.* : The Central Provinces of India.

*S. Ind.* : Southern India.

*Malay. Penins.* : The Malayan Peninsula.

*Masc. Isles.* : Madagascar, Mauritius, Bourbon, etc.

*Vy.* : Valley.

(Besides other usual and obvious abbreviations.)

## COLLECTORS' NAMES.

*Aitch.* : the late Dr. J. E. T. Aitchison.

*Beddome* : Colonel R. H. Beddome.

*Blanf.* : the late Mr. H. F. Blanford.

*Bliss* : Mr. T. Bliss.

*C. B. Clarke* : Mr. C. B. Clarke.

*Davidson* : Colonel Davidson.

*Duthie* : Mr. J. F. Duthie and his collectors.

*Edgew.* : the late Mr. M. P. Edgeworth.

*Gamb'le* : Mr. J. Sykes Gamble.

*Gammie* : Mr. G. A. Gammie.

*Hook. fil.* : Sir J. D. Hooker.

*Hope* : Mr. C. W. Hope.

*Jacquem.* : Jacquemont.

*King* : Sir George King.

*Lace* : Mr. J. H. Lace.

*Lev.* : the late Mr. H. C. Levinge and his collectors.

*Mackinnons* : Mr. P. W. Mackinnon and Mr. V. A. Mackinnon, and their collectors.

*MacLeod* : Colonel R. W. MacLeod.

*M'Donell* : Mr. J. C. M'Donell.

*Mann* : Mr. Gustav Mann.

*R. Blink.* : Mr. R. Blinkworth.

*S. & W.* : Strachey and Winterbottom.

*Trotter* : Mr. E. W. Trotter.

*T. T.* : Dr. T. Thomson.

*Watt* : Dr. George Watt.

(To be continued.)



## THE FERNS OF NORTH-WESTERN INDIA,

Including AFGHANISTAN, the TRANS-INDUS PROTECTED STATES, and KASHMIR : arranged and named on the basis of Hooker and Baker's *Synopsis Filicum*, and other works, with New Species added.

By C. W. HOPE.

(Continued from page 325.)

### PART II.

#### NEW SPECIES.\*

Genus 8—*DAVALLIA*, *Smith*.

Subgenus—*LEUCOSTEGIA*, *Presl*.

5. *Davallia Beddomei*, n. sp.—*Rhiz.* creeping on trees, hard, woody, branching, densely clothed with light-brown, large, broadly lanceolate-acuminate scales, peltately attached near the free base, thickly overlapping each other, not adpressed, persistent; *st.* articulated on rhizome, and clothed like it for a short way up, and with a few large scales scattered higher; *fr.* lanceolate-acuminate, sometimes much attenuate at apex, lowest pair of pinnae hardly shorter than next two pairs above, 5—14 in. l., and up to 6 in. br., bi-tripinnate, and sometimes deeply quadripinnatifid; *pinn* 15—20 pairs besides the pinnatifid apex, distant, lowest pair subopposite, others increasingly alternate until all are equi-distant, lanceolate and sometimes much acuminate, subequal-sided, lowest pair broadest and sometimes with inferior pinnules next the stipe enlarged; rhachis of pinna slightly winged; *pinnl.* up to 12 pairs besides the pinnatifid apex, those on superior side of pinna slightly longest except sometimes on lowest pair of pinnae, in fully fertile fronds cut down to a winged rhachis, leaving up to 6 pairs of tertiary segments free, which again are deeply cut down into three or more unequal-sided lobes either simple and non-soriferous, or cleft into unequal horns and then soriferous; *texture* herbaceous; *colour* of fronds olive green, —of stipes and rhachises more or less pink; *veins* of tertiary divisions pinnate in the lobes: veinlets of lobes simple or abruptly branched into two parts curving round into the hooked horns of the ultimate soriferous lobes; *sori* one at the base of each cleft lobe across the forked veinlet; *invol.* persistent, nearly as wide as the cleft lobes. (Plate I.)

PUNJAB: *Kullu* 9-10,000', Trotter; *Simla Reg.* 8-10,000', Collett, Blanford, Hope, Bliss, Lace: common at these elevations.

N.-W. P.: *D. D. Dist.*—*Jaunsar* 7-9000', Herschel, Duthie, Gamble, Mrs. Stansfield; *T. Garh.* 8-10,000', Lev., Mackinnons, Gamble; *Brit. Garhwal* 8-10,000', Duthie; *Kumaun* 8-12,000', Duthie, Trotter, MacLeod.

DISTRIB.—*Asia*: N. Ind. (Him.)—Nepal; Sikkim; Bhotan.

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\* The serial numbers prefixed to the New Species show their place under each genus in the General List (Part III), where the names only will be repeated.



I dedicate this beautiful species to Colonel Beddome, who has done so much for ferns, and who has shown me that it is undescribed. It is the high-level plant which is not got in the parts of the Himalaya most frequented by Europeans, and consequently has been seen growing, or noticed, by few collectors. It can never be mistaken, in growth at least, for the low-level plants, so common in the outer range of the Himalaya, be these *D. pulchra*, or *D. pseudocystopteris*, or *D. Delavayi*. The fronds are never deltoid, or even subdeltoid, in shape, as are those of *D. pulchra* and *D. pseudocystopteris*, and the stipes are generally comparatively short, and, like the rhachis, pinkish in colour, which tinge gives a character to the plant. The large, broad scales of the rhizome, suggesting pale-coloured raisin skins, are very characteristic. It is sometimes difficult to separate the members of this group by their ultimate cutting, as that seems to vary with age of fronds and degree of their fertility; but I consider the difference in shape of fronds, in scales, in colour, and in habitats to be quite sufficient distinction. Blanford, who called this plant *D. pulchra*, Don, said—"The typical form, distinguished by its red rhachis, obtuse segments and ovate scales of the rhizome, is abundant on trees on Kamalhari and Hatu (Mts.) above 8,500 ft., but does not occur lower."

Genus 12—CHEILANTHES, Sw.

6. *Cheilanthes dubia*, n. sp.—*Caud.* erect, undistinguishable—hidden by the numerous stipes; *st.* densely tufted, stout, round, about as long as the fronds, when young—thickly covered with linear-lanceolate hair-pointed scales with dark centres, which diminish in size and become paler in colour upwards, and are there mixed with small, pale-brown, chaffy scales and tomentum; when old, less densely clothed, and then appearing glabrous and almost black between the scales; *fr.* lanceolate, sometimes 1 ft. and upwards in length, pinnate; *pinn.* pinnatifid nearly to the rhachis, lower pinnæ as long as or longer than those next above, and with lower sides enlarged; *fr.*, of two sorts, (1)—the broader herbaceous in texture, with pinnæ and segments broad, destitute of powder beneath, secondary rhachises and costæ with a few, narrow, pale-brown scales, but no tomentum; *invol.* distinctly separate at tips of veins, often not extending to apices of segments, and often without sori, (2)—the narrower coriaceous in texture, with pinnæ and segments shorter and narrow; *rhachises* and costæ densely clothed with pale-brown to nearly white broad and also long chaffy scales, and tomentum, and under surface of lamina completely covered with white powder; *invol.* broad, confluent, all round the segments, much lacerate and ciliated. (Plate. II.)

N.-W. P.: *D. D.* *Dist.*—On the cart road from Rajpur to Mussooree, at about 4,000 ft. altitude.





N.E. Brown del.

Chitra Salpi C. lith.

## DAVALLIA BEDDOMEI, n. sp

1. Rhizome and part of a frond natural size.
- 2 & 3 Entire pinnae from the middle of two other fronds, natural size.
- 4 Portion of a pinna from the frond fig. 1, magnified 3 diameters.
5. Portion of a pinna from the pinna fig. 2 magnified 3 diameters.
6. Sorus with indusium, magnified 10 diameters.
- 7 & 7a. Scales from rhizome magnified 5 diameters.
- 8 Cells from the middle of a scale, magnified 30 diameters.





N.E. Brown del.

CHEILANTHES DUBIA, n. sp.

A.C. Smoot lith

1. Portion of plant shewing the two kinds of fronds, A & B.  
 2. Pinnule of semi-barren frond,  $\times 3$ .  
 3. " " fertile frond,  $\times 3$ .

4. Indusium from fertile frond,  $\times 10$ .  
 5. Scales from stipes,  $\times 5$ .  
 6. Portion of scale from stipes,  $\times 30$ .





This fern grows near the highest range of *C. rufa*, Don, and at about the lowest range of *C. albo-marginata*, Clarke, which two species are very unlike each other in general appearance and habit, perhaps agreeing only in having two sorts of fronds, differing as above described. It is much larger than *C. rufa*, and has the general appearance of very large plants of *C. albo-marginata*, except that none of its fronds are deltoid as some of those of the other species are; but it bears fronds some of which might be referred to one species and some to the other, and, as I cannot refer it as a whole clearly to either, I give it an independent name. It may be a hybrid between *C. albo-marginata* and *C. rufa*.

Colonel Beddome says (Handbook, p. 94), under *C. rufa*—"Very near the last species" (*C. albo-marginata*) "only tomentose. I have some specimens from Garhwal. I hardly know which to refer to, the tomentum being present, but very sparse; the difference between the two is only a question of the tomentum, and both may well be varieties of *farinosa*." I lived for sixteen years in Dehra and Mussooree in the midst of these species of *Cheilanthes*, and I must say I know of no three species of any genus which are more markedly separate in character and general appearance than these three are. *C. farinosa*, in those parts at least, never varies, and is as typical when growing in the Raspana Valley at Rajpur alongside of *C. rufa* as it is many miles south of any known habitat of that fern. *C. albo-marginata* looks quite a different plant when growing in exposed rock crevices, or on walls, from itself growing in soil and shade, but it is always clearly distinguishable from *C. rufa*. *C. rufa* is always spread out flat on the face of the rock in which it is rooted, though occasionally it grows in soil above or below rocks. I think I have never seen *C. farinosa* rooted in rock. I do not think Colonel Beddome has ever seen *C. rufa* growing. He has probably been misled by the fact that both that species and *C. albo-marginata* are somewhat dimorphous, though where the resemblance of either to *C. farinosa* is I cannot see.

#### Genus 20—ASPLENIUM, Linn.

##### Subgenus—ATHYRIUM, Roth.

**22. *Asplenium tenellum***, n. sp.—*Allantodia tenella*, Wall. in Herb. 1821, under *Asplenium tenuifrons*, Wall. Cat. No. 206. Plants isolated, 10—22 in. high, according to age; *caud.*, erect, small: *st.* tufted; or, if constrained, procumbent, and stipes springing in close longitudinal sequence: a few lanceolate-acuminate brown scales on base of stipes; *st.*, except close to base, naked, slender, sometimes nearly equalling the frond in length; *fr.* broadest at middle or below it, narrowing slightly towards the base and rapidly towards the acuminate apex, bipinnate, 6—13 in.



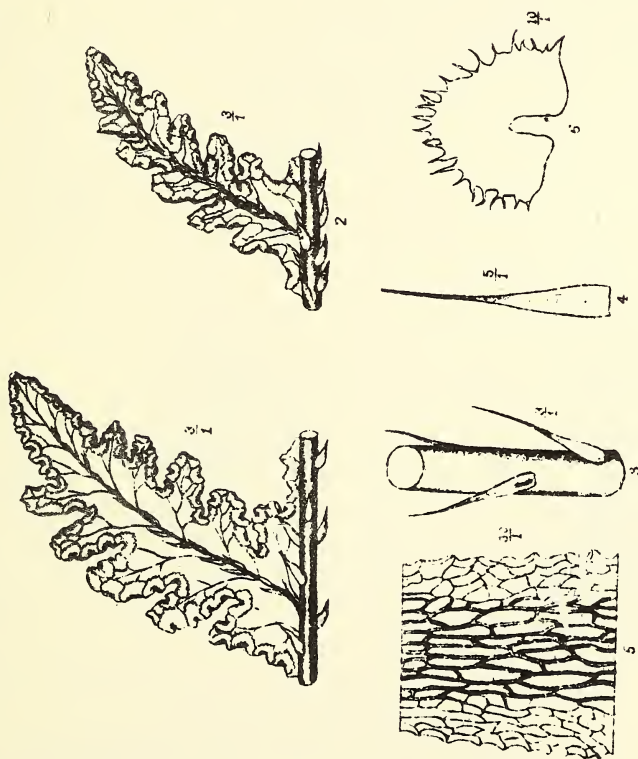
l., rarely longer, 3—6 in. br. ; *pinn.* 10—18 pairs (according to size of frond) besides the acuminate apex, well apart, stalked, ovate-acuminate,  $1\frac{1}{2}$ —3 in. l.,  $\frac{1}{2}$ —1 in. br., sometimes broadest at base, generally like the frond in miniature ; secondary rachis flat above, keeled below, becoming winged above the lowest few pairs of pinnules ; *pinnl.* 6—12 pairs below the acuminate apex of the pinna, oblong and blunt to falcate, unequal-sided, lower side cut away, divided more or less deeply into 4—6 pairs of blunt toothed lobes or segments ; upper surface furnished with long weak *setæ* springing from the sides of the secondary rachis and the costa of the pinnule, and in large fronds also from the veins ; *texture* herbaceous ; *ven.* pinnate in the pinnules, and forking in the ultimate segments ; *sori* in a double row close to the costa along the vein and the superior veinlet of each lobe, sometimes one, or a pair, away from the costa in the anterior lowest segment ; *invol.* persistent, opening towards the costa or the main vein of the enlarged lowest segment. (Plate IV.)

HAB. :—KASH. : *Kishtwar*, T. T. 14-11-48. PUNJAB :—*Simla Reg.*—Simla 6-7000', Blarf. 1883, Bliss 1891. N.-W. P. : *D. D. Dist.*—Sowārna Nāla 4500', Mackinnons 1878-79, P. W. Mackinnon and Hope 1881 ; *Kumaun*—Jagesar and Phurki 6000', S. and W. 1848 ; near Naini Tal 5500', Hope 1861 ; Rālam Valley 7-8000', Duthie No. 3621, 21-8-84 ; Khāti to Dwāli 70-7500', Trotter No. 817, 1891 ; Gori Valley above Bugdiār 9000', MacLeod 1893.

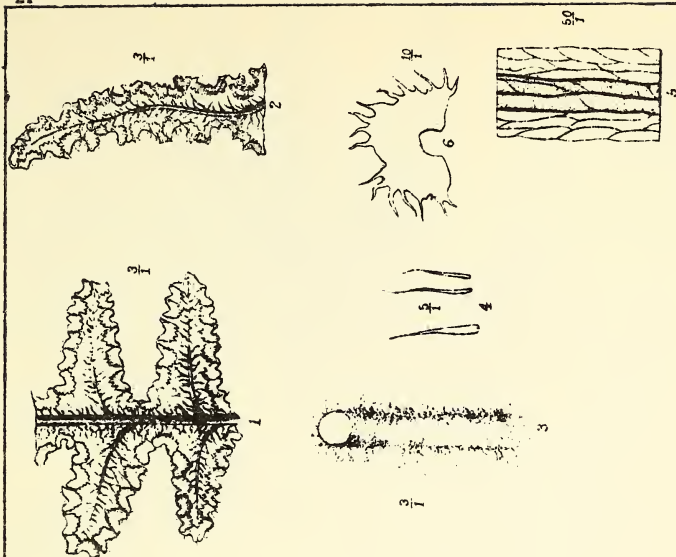
DISTRIB.—*Asia* : N. Ind. (Him.) W. NEPAL : Nampa Gadh 12-13,000', J. R. Reid 1886, com. Duthie No. 6244 : very long. Nepal, *Wallich*, *Duthie*.

A small and elegant plant, found on wet rocks, or by the side of small streams, in forests on the Himalaya. Intermediate between *A. nigripes* and *A. tenuifrons*, Wall. Distinguishable from the former by the shorter stipes, more delicate habit and more elegant cutting, and distinguishable from *A. tenuifrons* by the smaller size of the plant, slender stipes, generally more attenuate pinnae, and by not being proliferous towards the apex of the fronds.

*A. tenellum*, Wall., is given in Hooker and Baker's *Synopsis Filicum* as merely a form of *A. Filix-femina*, Bernh., "with the midrib of the pinnae and pinnules beset with firm yellow spines or strigillæ ;" but in the living state the two plants are altogether unlike. In the Wallichian collection in the Herbarium of the Linnean Society, there is only one frond ticketed by Wallich, *Allantodia tenella*, Wall., "*Legi in Napalia 1821*" : it is long and narrow— $11\frac{1}{3}$  in. l., 4 in. br., with sori very costal, like the Sikkim high-level plant which Mr. Clarke called *var. alpina* of *A. nigripes*, and the Khasi Hill specimens alluded to in this paper under *A. nigripes* : the pinnae are distant and very narrow—about  $\frac{1}{2}$  in. br. only, and just enough of the upper surface is visible to show that it is setulose. In the British Museum Herbarium there are two sheets marked "*Allantodia tenella*, Wall. in Herb. 131" (possibly



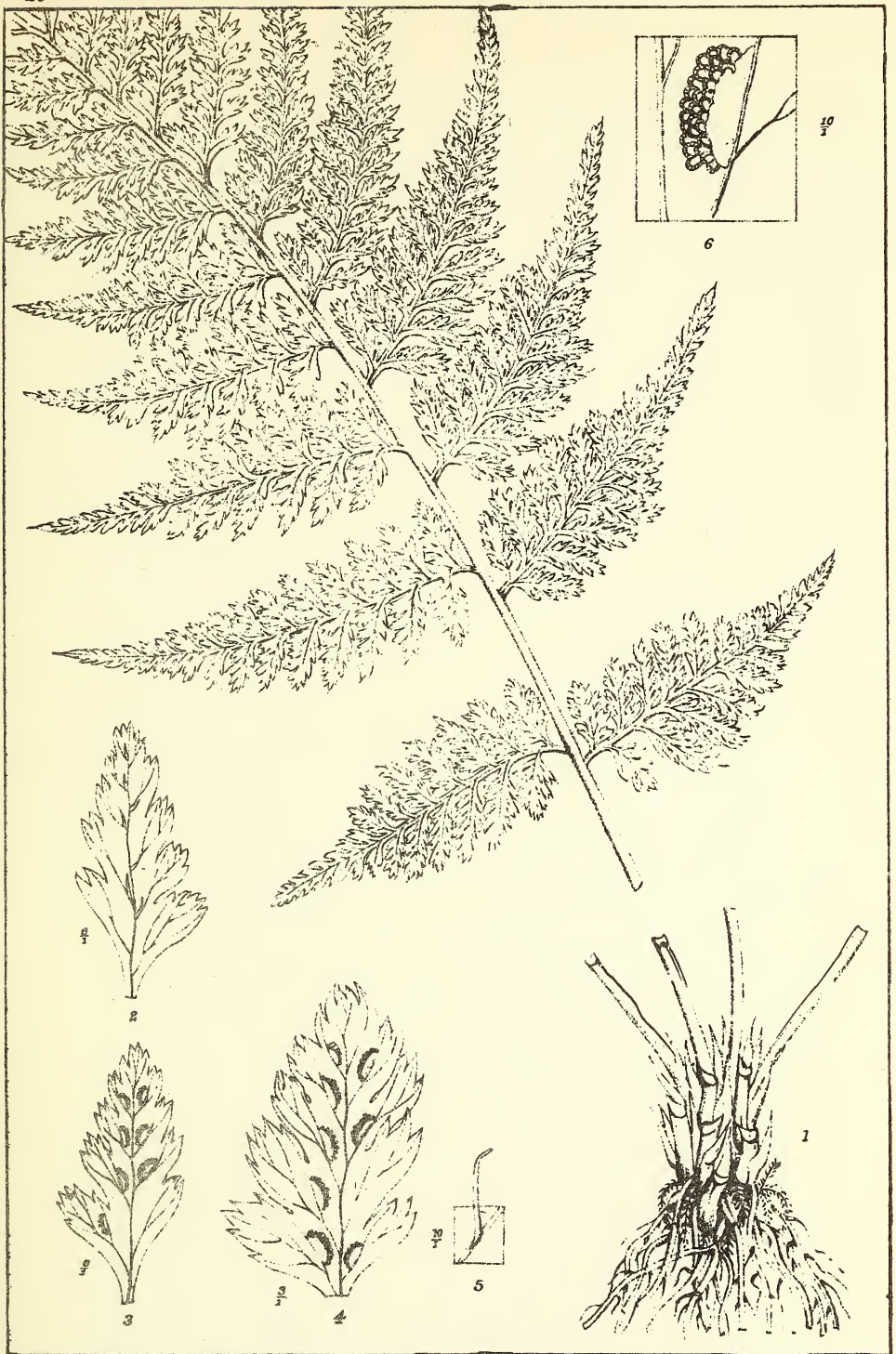
N.E. Brown del. CHEILANTHES ALBOMARGINATA, C. B. Clarke.



A.C. Mookerjee lith. CHEILANTHES RUFO, Don.

1. Part of a pinna from a bipinnate frond,  $\times 3$ .
2. An entire pinna, from a pinnate frond,  $\times 3$ .
3. Portion of stipes,  $\times 3$ .
4. Scales from stipes,  $\times 5$ .
5. Fragment of scale from stipes,  $\times 50$ .
6. Indusium,  $\times 10$ .





N.E. Brown, del.

Chitra Silpi Cº lith.

## ASPLENIUM TENELLUM. n. sp.

1. Rhizome and part of frond, natural size. 4. Pinnalet from a broad frond, under side,  $\times 3$ .  
 2. Upper, and 3, under side of pinnalet from an ordinary frond,  $\times 3$ . 5. Fragment of a pinnalet showing bristle on upper surface,  $\times 10$ .  
 6. Fragment of a pinnalet showing sorus with its indusium,  $\times 10$ .





Cat. No. 231 is meant, as *A. pectinatum*, Wall. Cat. 231, with some *A. nigripes*, is mixed).

Moore, in the *Index Filicum*, gives *Allantodia* (?) *tenella*, Wall. as a synonym of *Athyrium tenuifrons*, Moore.

**26. *A. rupicola*, n. sp.**—*Plants* isolated; *caud.* suberect or procumbent, slow-growing; *st.* densely tufted, springing from all round the caudex, short and thick and curving towards the vertical, the bases persistent, clothed with narrow hair-pointed dull brown scales, above glabrous; *fr.* narrow lanceolate, acuminate at apex, simply pinnate, deeply pinnatifid, naked except for a few fibrillæ on main rhachis, herbaceous to subcoriaceous, generally curving laterally near the base reversely from the direction of the stipes, the lower pinnae becoming distant and dwindling in size; up to 15 in. l. and probably more, by 3—4 in. br., rarely broader; *pinn.* 20 or more pairs besides apex, becoming distant towards the base of the frond, sessile and decurrent both ways on rhachis which becomes winged towards apex,  $\frac{3}{8}$ — $\frac{1}{2}$  in. br., falcate, broadest at base and anterior lowest segment longest cut down sometimes nearly to the secondary rhachis into broad falcate segments spinulosely toothed at point and on both sides, or, in large specimens, lobed, and then the lobes spinulosely toothed in correspondence with the veinlets; *ven.* pinnate in the segments; *veinlets* one to each tooth or lobe, and forked in the lobes; venation distinct on the lower surface; *sori* one to each vein, on the anterior veinlet of each lobe, or in the fork of the veinlets, short, straight, or sometimes hippocrepiform, looking large and roundish when ripe; *invol.* brown. persistent at least till sori ripen. (Plate V.)

The above description has been written from fifteen sheets in my possession: there is no other description, except that Beddome gives *A. rupicola*, Edgew., as a synonym of *A. Filix-fœmina*, var. *retusa*, Clarke, which he describes briefly. Some at least of Clarke's *retusa* is quite different from the present species.

HAB.—KASHMIR, Pir *Punjal*, south slope 9000', Lev. 1875. PUNJAB—*Chamba* 8000', Baden-Powell 1879, 9000' McDonell; *Kullu* 7-8000', Trotter; *Mandi State* 9-10,000', Trotter; *Simla Reg.*—Simla, Edgew., and Nagkanda 29-9-31, Lady Dalhousie, Herb. Wight, in Herb. Hort. Kew, 7800', Bliss; Ridge east of Simla from Mahasu to Baghi 8-10,000', Gamble, Collett, Blanf., Hope, Trotter, Bliss.

N.-W. P.: *D. D. Dist.*—Jaunsar 7500', Gamble; Mussooree 7000', Hope (once seen). *B. Garh.*—near Kuari Pass. 11-12,600', Duthie No. 5150; *Kumaun*—Naini Tal Davidson 1875, China Mt. 8500', Trotter; Byans—Palang Gadh 9-10,000', Duthie; Pindar Gorge 9-10,000', Trotter No. 885 (whole plant 5 in. high, fronds fertile, 1 in. br.); Gori Ganga Valley—Bugdiar 8600', MacLeod.

This is a very distinct species, both in structure and habit. It grows in the crevices of dry exposed rocks, and, late in the season at least, always has

stumps remaining of stipes representing fronds larger than any then existing. Probably the longer fronds get broken off by the wind, or cropped by cattle or goats, during the rainy season. Blanford had been calling the plant *A. Schimperii*, A. Br., narrow form; but when I collected it in 1886 I thought it distinct and new, and proposed to call it *A. rupestre*. On going to Kew in 1888 I found a specimen collected by Edgeworth, and named by him *A. rupicola*. Meanwhile, Mr. Blanford seems to have entered the fern in his list of the Ferns of Simla (Journ. Asiat. Soc., Beng. 1888) as *A. Filix-femina*, var. *retusa*, Deene., subvar. *elongata*, Clarke, from sheets at Kew so marked by Clarke. This subvariation is too metaphysical for me, and, as the plant is unlike *A. Filix-femina* in every respect, I give it as a species, and adopt Edgeworth's name as being very appropriate. I disagree with Beddome when he says that the fronds are very similar to those of *A. Schimperii*, A. Br., but almost always only bipinnatifid. *A. rupicola* is very gradually narrowed towards the base, whereas *A. Schimperii* is hardly narrowed at all; and I have never seen the first-named species with fronds even nearly bipinnate; but probably Beddome, as Clarke does, includes in the variety *retusa* of *A. Filix-femina* other plants which I do not know. In the Calcutta Herbarium I found, and separated, a good many specimens of *A. rupicola*, but I omitted to note particulars regarding them.

Genus 22—*ASPIDIUM*, Sw. (in part). *R. Br.*

Subgenus—*POLYSTICHUM*, Roth.

**3. *Aspidium Duthiei*, n. sp.**—*Plants* with erect caudices in dense tufts; *st.* short, stout, 1—2 in. long, densely clothed with large pale-drab, almost straw-coloured, scales, which extend up the *rhachis* to the apex of the frond, diminishing in size upward, and along the costæ on both surfaces, underneath protruding from among the sori; *fr.* 2—4, 5 in. l., narrow, linear, simply pinnate; *pinn.* short, blunt, hardly auricled, broadened at base on both sides, merely lobed or crenate above, markedly alternate; upper surface covered with small white glands or setæ; *texture* subcoriaceous; *sori* about 4 pairs to a pinna near the costa. (Plate VI.)

N.-W. P.: *T. Garh.*—Dudu Glacier 14-15,000', Duthie No. 396, 19-8-83; Kutti Valley, above Napálcha, 13,300', Duthie No. 3708 (in part); *Kumaun*—Lebong Pass 16-17,000', Duthie No. 6234, 1886.

NEPAL, WEST—Nampa Gádih 13-14,000', Duthie No. 6233, 1886.

I have felt obliged to separate this plant from *A. lachenense*, Hook., both because it differs from that plant in appearance, and because Hooker's description of *A. lachenense* cannot be made to cover it. Nor is that description correct for even the type plant, especially as to the cutting of the pinnæ, which can hardly



N.E. Brown del.

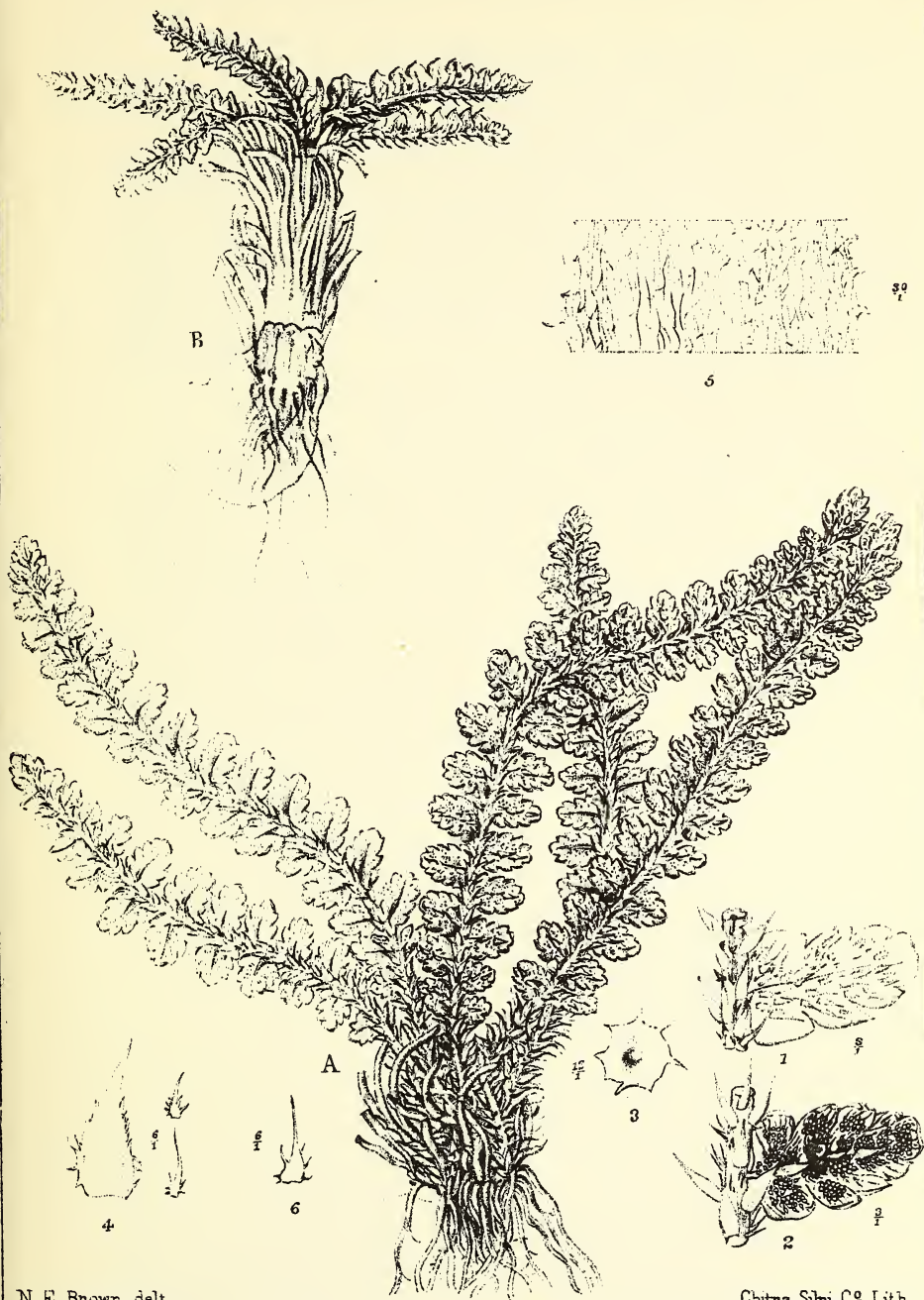
A.C. Singha lith.

*ASPLENIUM (SATHYRIUM) RUPICOLA*, n. sp.

- 1 Rhizome & frond, natural size.
2. Base of a pinna, showing four pinnules with nature sori, enlarged 3 diams.
3. Fragment of a pinnule with 3-toothed lobes & sori with their indusia, enlarged 3 diams.
4. Young sorus with indusium, enlarged 10 diams.
5. Indusium flattened out, with the sporangia removed, enlarged 10 diams.
6. Scale from the apex of the rhizome.







N. E. Brown. del.

Chitra Silpi C. Lith

A. Plant, natural size }  
 B. D? D? }

# ASPIDIUM DUTHIEI, n. sp.

- 1 Pinnule and part of stipes, upper surface,  $\times 3$ .
- 2 " " " under "  $\times 3$ .
- 3 Indusium  $\times 12$ .
- 4 Scales from stipes  $\times 6$ .
- 5 Portion of scale from stipes  $\times 30$ .
- 6 Scale from upper surface of pinnule  $\times 6$ .



be called serrate, much less "spinoso-serrated" (Syn. Fil.), or "spinously-serrated or crenate-serrate" (Bedd.). Clarke says—"Margin crenate-serrate, scarcely spinulose." I should say certainly not spinulose. The pinnae of neither plant are auriculate, as those of most Polystichums are. The distinguishing features of *A. Duthiei* are—the short and stiff stipes and stout rhachis; the dense covering of disproportionately large, very pale, scales: and the white setae on the upper surface, and the coriaceous texture. Judging from the few plants which have been gathered, some with few fronds left on them, but with numerous stumps of thick stipes, this species produces larger fronds than have yet been seen.

Genus 23—NEPHRODIUM, *Rich.*

Subgenus—LASTREA, *Presl.*

4. *Nephrodium Gamblei*, n. sp.—*Plants* isolated; *caud.* erect or suberect; *st.* stout, 9—24 in. l., densely clothed throughout with long dull-brown scales up to  $1\frac{1}{4}$  in. l. by  $\frac{3}{16}$  in. br., which diminish in size rapidly and get darker in colour above two or three inches from the rhizome; *rh.* similarly clothed throughout with dark brown or black hair-like scales which extend a short way along the *sec. rh.*; *fr.* simply pinnate,  $1\frac{1}{2}$ —3 ft. l. by 9—13 in. br.; *pinn.* up to 30—35 pairs, very shortly stalked, cordate with bases sometimes overlapping the prim. rh., narrow, generally broadest at base owing to enlargement of lowest pair of segments, above that  $\frac{5}{8}$ — $\frac{7}{8}$  in. br., hardly narrowed below middle of length, and above that gradually to a not very acuminate point, cut down  $\frac{1}{4}$ — $\frac{1}{5}$ th towards *sec. rh.* into numerous segments, one for each main vein with margins rounded upwards from the sinus, the lower afterwards running parallel with the *sec. rh.* to an ogival mucronate point, margin sometimes undulate and slightly toothed; *texture* coriaceous, brittle when dried; *ven.* pinnate in the segments, lowest pair of veinlets taking off at or near costa of pinna and curving upwards to near the sinus, but sometimes stopping much short of it and then often not soriferous, others running into the lobes, and all stopping short of the margin and having thickened ends; *sori* small, 2—3 to a segment, on lowest pair of veinlets and next veinlet above, appearing grouped in triplets—two sori belonging to one segment and the third to the next superior segment; *invol.* shrivelling on top of ripe sori, but often persistent. (Plate VII—drawn from a Darjeeling specimen.)

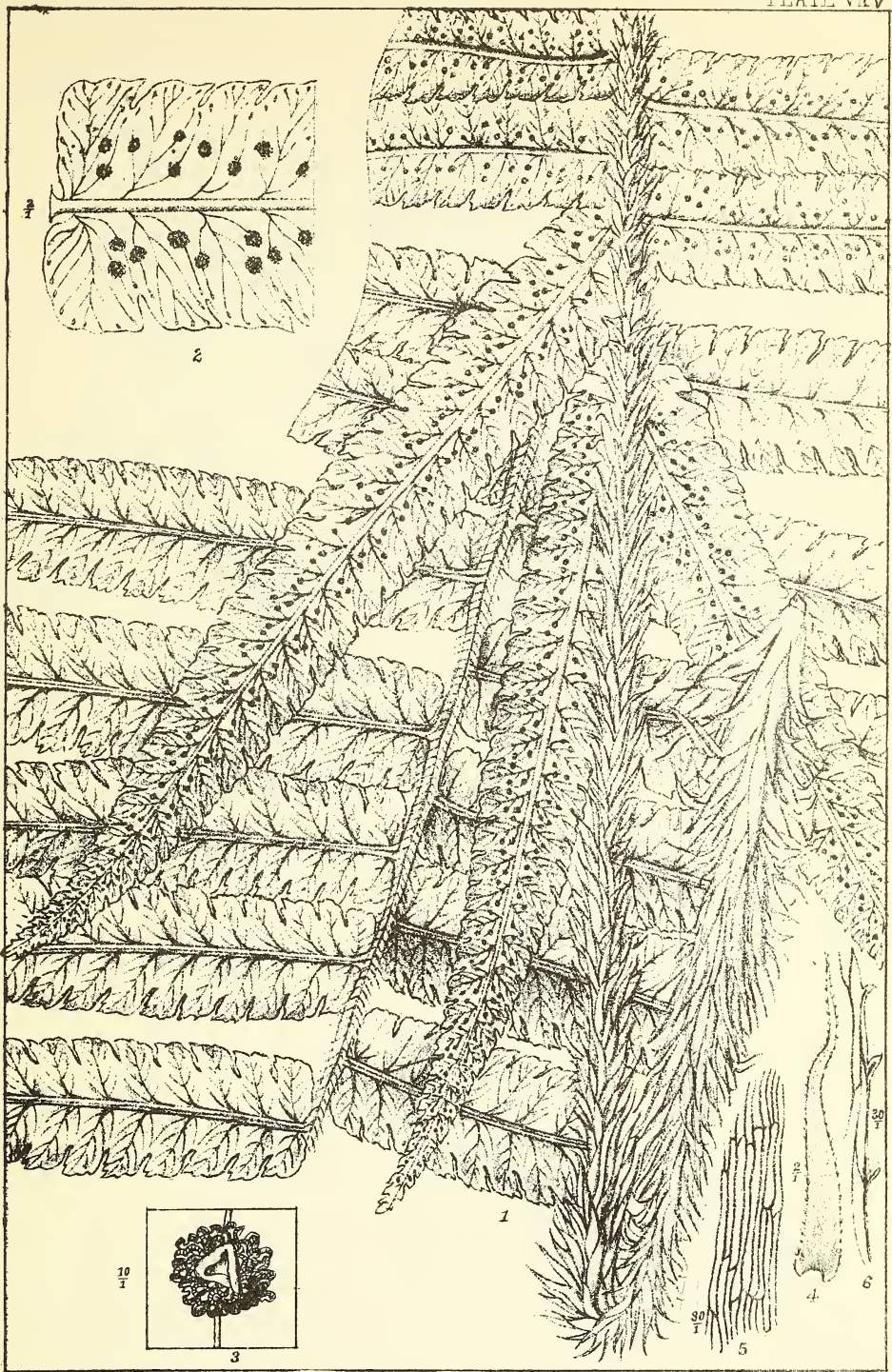
PUNJAB: *Simla Reg.*—"Above Simla, Col. Bates," *vide* Hooker in Herb. Hort. Kew. "Lastrea atrata ?? Wall." N.-W. P.: "*Garhwal*"—P. W. Mackinnon 1881; *Kumaun*—S. and W. 1848, No. 3.

DISTRIB.—*Asia*: N. Ind. (Him.) Sikkim—Darjeeling 6700', Gamble 1879, Nos. 6968 and 7075, Lev. 1899, 7006'; Bhotan—Dhumsong 6000', Gamble 1876, No. 254; Assam—Shillong, Clarke 44635, 1886.



Many years ago I separated, from among *Nephrodium F. mas*, var. *parallelogrammum*, Kze. in Linnaea, Hook, in the collection of the Messrs. Mackinnon, several specimens as differing in cutting and venation. And more recently I observed in Mr. Gamble's collection, in the *N. hirtipes* wrapper, the specimens above enumerated from Darjeeling, Bhotan, and Shillong, the two latter sets having been marked by Mr. Clarke *Lastrea hirtipes*. On the ticket of No. 7075 Mr. Gamble had written—"This seems to be placed by Clarke together with what we have usually considered true 'hirtipes' (see my No. 7154), but the two ferns are quite distinct in locality and habit. No one gathering them together in Darjeeling could say they were the same!" When I told him I agreed as to this specific difference, and that I proposed to describe the plant as a new species, Mr. Gamble gave me this specimen. Except that the frond and pinnæ are narrower, and that the scales on it are paler, I cannot see that the North-West Indian plant is different. The venation is like that of *N. hirtipes*, but with perhaps more veinlets in a group. I have not seen either plant growing; but even without the support of Mr. Gamble, who has gathered both, I should have no hesitation in describing the present as a new species, distinct from *N. hirtipes*—the principal points of difference being (1) the stouter stipes and rachis; (2) the more numerous and narrower pinnæ—the lower ones deflexed; and (3) the fewer sori. The free portion of a segment resembles in outline the head of a bird with a small beak.

I observed some specimens of *N. Gamblei* in the Calcutta Herbarium, but had not time to note particulars of them. In Mr. Levinge's collection in the Dublin Museum I have lately seen a very fine specimen of this fern, named *N. hirtipes*, which I noted as having a thick stipe 19½ in. l. with a frond 28 in. l. by 13 in. br. below the middle, and almost 12 in. at the base measured along the deflexed pinnæ. There are about 35 pairs of pinnæ, besides the abruptly narrowed apex. The texture is coriaceous. And in the Edinburgh Herbarium—which has lately been greatly enriched by the acquisition of the late Colonel F. Henderson's collection of ferns—I found a still larger, though imperfect, frond which must have been 3 ft. in length, besides the incomplete stipes which is 22 inches. This is the Bhotan specimen cited above, and Mr. Gamble's ticket bears—" *Nephrodium hirtipes*, Hook., ex C. B. Clarke, but in my opinion a different species." With this specimen, which is unmounted, is a loose slip, in Mr. Levinge's writing, as follows:—"We always called this fern *L. cuspidata* here; but it clearly is not. It differs from the typical *L. hirtipes* considerably, especially in habit, growing in great tufts like *L. patentissima*. I think it should be considered a variety (initialed) H. C. L. 14-11-80." Another slip in Colonel Henderson's writing bears:—"These specimens are



N.E. Brown. del.

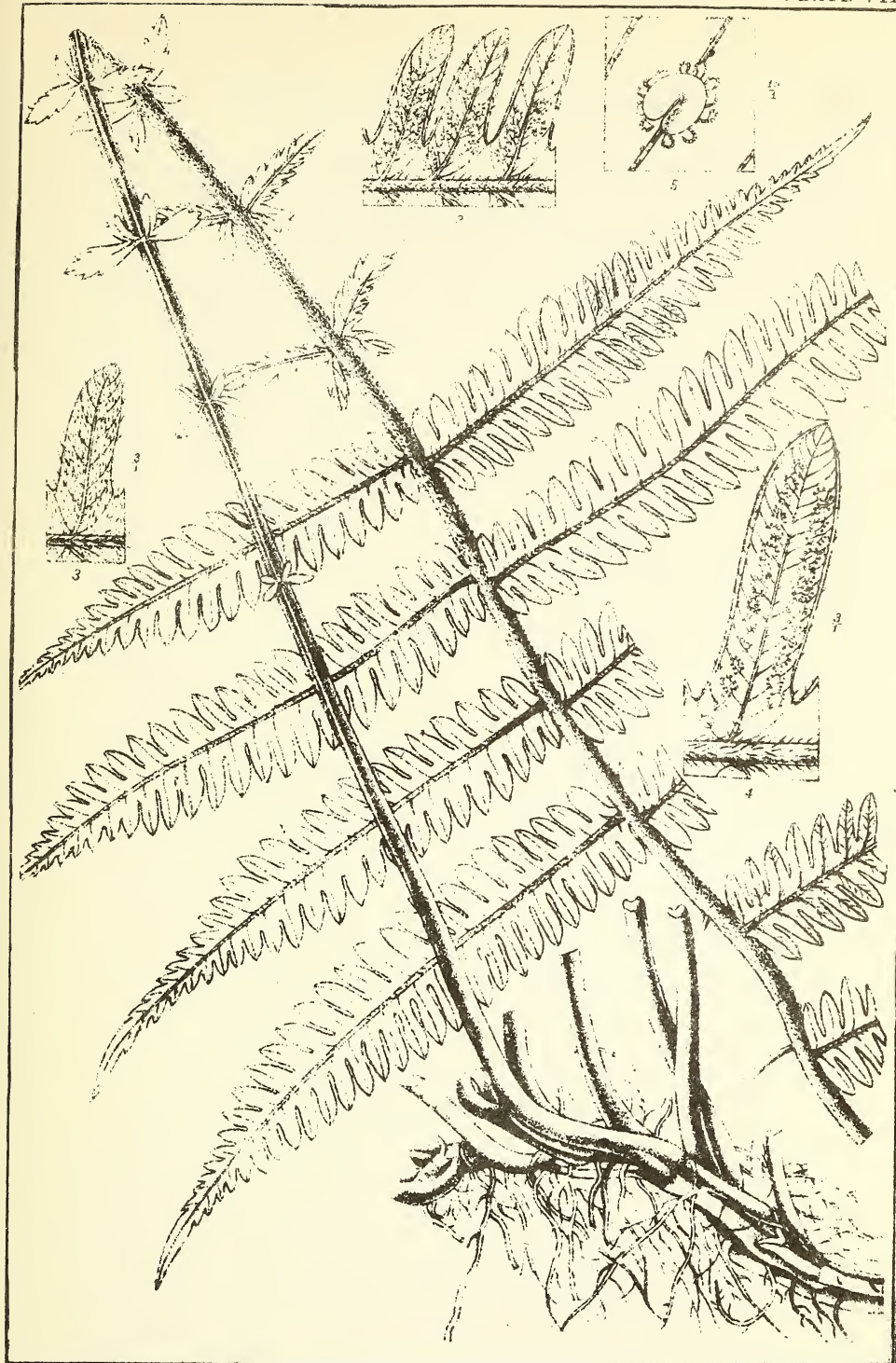
Chitra Sita C. lith

*NEPHRODIUM GAMBLEI*, n. sp

1. Small frond, natural size.
2. Base of a pinna, under surface, magnified 2 diameters.
3. Sorus with indusium, magnified 10 diameters.
4. Scale from base of stipes, magnified 2 diameters.
5. Cells from the centre of a scale, magnified 30 diameters.
6. Marginal cells of a scale magnified 30 diameters.







N. E. Brown del.

NEPHRODIUM REPENS, n. sp.

A. C. Smgha lith.

1. Rhizome & portion of a frond, natural size.
2. Three lobes of a pinna, under surface, X3.
3. Lobe of a pinna, upper surface, X3.
4. Lobe of a pinna from a large frond, under surface X3.
5. Fragment of a pinna with sorus & indusium, X15.





from the Himalayas, and though I suppose you will call them *L. hirtipes*, they seem to pass on and run into *Lastrea cuspidata*." I need not here consider whether *N. cuspidatum* and *N. hirtipes* are distinct species ; but I may say that I think *N. Gamblei* is the farther removed from *N. cuspidatum*. I have seen one or more specimens named *N. hirtipes* in Colonel Beddome's collection, which I should name *N. Gamblei*.

**6. *N. repens*, n. sp.**—*Rhiz.* widely creeping and branching, and throwing up fronds  $\frac{1}{2}$  in. to 1 in. or more apart (sometimes forming dense beds)  $\frac{1}{4}$  in. thick ; stiff and ligneous when dried ; *st.* naked or with a few deciduous scales at base only, upwards becoming downy or villose, as are the rhachises, 3—6 in. long below the auricles of the frond, rarely longer ; *fr.* ovate with an acuminate apex, but suddenly reduced below and continued by almost linear-auricles down the stipe, which dwindle in size until scarcely visible, auricles sometimes bipartite with segments pointing up—and downwards, simply pinnate, 2—4 ft. long including auricled base, by 6—12 in. br. ; *pinn.* numerous, close, not generally more distant towards base (but the auricles increasingly so), acuminate, width from  $\frac{1}{2}$  to 1 in., rarely more, generally under  $\frac{3}{4}$  in., cut down nearly to the sec. rh. into very numerous narrow parallel-sided round-pointed segments which are closely set—though always separated by a narrow sinus, slightly curved upwards at apices ; *texture* herbaceous or sometimes subcoriaceous, the costa thickly and the veins sparsely clothed on both surfaces with short hairs or down ; *ven.* of segments simply pinnate, attached to or abutting upon, but not branching from, the rhachis of the pinna ; *ven.* 6—18 pairs of veins, running out to the edge, the lowest pair just above the sinus ; *sori* small, one on each vein except near apices of pinnæ and segments, where they are wanting, medial or sometimes rather nearer the margin ; *invol.* glabrous, persistent, sometimes shrivelling. (Plate VIII.)

PUNJAB : *Chamba*—Chao (pi Sao) 6000', C. B. Clarke 23605, 7-10-74 (?) ; Ravi Valley 5000', Blanf. ; Chamba 6-7000', J. Marten 1897 ; *Mandi State* 8000', Trotter ; *Kulu* 6-7000', Trotter ; *Simla Reg.*—Simla 5000', Collett ; the Glen 6000', Gamble ; Usan Valley 4300', Blanf. : " Common in ravines below 6000'," Blanf. in List (under *N. prolixum*) ; Bliss 1890, several stations. N.-W. P. : *D. D. Dist.*—Jaunsar ; Rupin Valley 4500', C. G. Rogers ; Tons Valley 3000', Gamble ; "Dhoon" (in the Dehra Dun) Vicary ; Suarna Nala 4500', P. W. Mackinnon and Hope 1881 ; Sahasradhara 2000. Hope ; Mussooree—in Herb. Dalzel, King, Herschel, Mackinnons, Hope ; *T. Garh.*—Phedi 4-5000', Duthie ; *Kumaun*—Karim 300', S. and W. ; Naini Tal, Hope 1861 Chippleshat and Koonoor, Davidson 1871 ; near Askot 4-5000', Duthie 1884 ; Nalena Valley 47-5000', Hope 1890 ; near Bana 6500', Trotter 1891 ; Kaini Valley—Shama 4200', MacLeod 1893.

DISTRIB.—*Asia* : N. Ind. (Him.) Nepal—*Wallich* 349. Aspid. No. 29 ; " Legi in Nepalia 1821 " ; Sikkim and Bhotan (?) ; Assam—Shillong 6000', C. B. Clarke. W.

*Afr.* : Sierra Leone—near Free Town, *H. H. Johnston*. *S. Afr.*; Madagascar ? (*N. longicaule*, Baker).

In giving habitats for this fern I am obliged greatly to assume from their other characters what sort of rhizome many herbarium specimens must have had. As already said, under *N. proluxum*, Baker, I have seen no plants of this section from North-West India with an erect caudex and tufted stipes. I should now add—except of the next species *N. xylodes*, Kze. In the *Synopsis* nothing is said as to the rhizome of *N. proluxum*, Baker, though that is sometimes the most important part of a fern; nor does Willdenow mention that of his *Aspidium proluxum*. Nor does Clarke say anything as to rhizome, but says—“tufted,” meaning stipes in tufts, which I consider to imply that the caudex is thick and erect or suberect. Beddome is bolder, and in giving *Lastrea ochthodes*, of which he says *N. proluxum*, Baker, is a synonym, he writes—“Caudex erect, stipes tufted.” And among all the specimens in the Kew Herbarium, named *N. ochthodes* and *N. proluxum*, there is not one with an erect caudex, and I think only one with a creeping one, namely, Mr. Clarke’s No. 44652, collected at Shillong 6100’, 6-9-86; and to the fact of the creeping rhizome Mr. Clarke has called attention, as though it were an abnormality.

On referring to Kunze’s description of *Aspidium ochthodes*, I find he says—“*Rhizoma juvenile tantum observari*,” and of *A. xylodes* he says only—“*rhizomate*. . . .” As to the shape of the frond, Kunze says *A. ochthodes* differs from *A. xylodes* among other particulars in having “*basi sensim attenuata*”; and *A. xylodes* from the other, thus—“*basi abrupta contracta*.” Kunze’s *N. ochthodes*, therefore, has a frond gradually attenuated at the base, and not suddenly reduced to mere auricles as in *N. repens* and *N. xylodes*.

Hooker in the *Species Filicum*, IV, p. 109, gives No. 87 *N.* (*Lastrea*) *ochthodes*, Hook., and for description a verbatim copy of Kunze’s; and then—“var. *a*, frond much attenuated at the base by the dwarfing of the pinnæ. *Aspidium ochthodes*, Kze. in Linnæa, XXIV, p. 282. Mett. Aspid., p. 82; var. *β*, the lowest pair (several pairs) suddenly abortive, reduced to large tuberculated glands. *Aspid. tylodes*, Kze., in &c.; Mett. Aspid., p. 82, vix ab *Aspid. ochthode* diversum videtur. *Aspidium glanduliferum*, Wall. Cat. 347.” Wallich’s type sheet of No. 347, *Aspid. glanduliferum*, Wall. “Napalia 1821,” is the plant I take to be *N. proluxum*, Baker, with pinnæ gradually reduced in length below and broadening into butterfly-shaped auricles; there is no rhizome: the stipe, though incomplete, is  $3\frac{1}{2}$  in. l.; and there are about 19 pairs of auricles diminishing in size to a mere trace only. Baker’s *N. proluxum* is said to have a prominent gland at the base of the pinnæ. I can see no glands on any specimens of *N. repens*.

No. 349, *A. appendiculatum*, Wall., in the Linnean Society's Herbarium—"Aspid. No. 29: Legi in Napalia 1821," named by Mr. Clarke—*N. canum* Baker, *v. prolixum*, Baker, is *N. repens*; there is no rhizome, but the frond is suddenly diminished to mere short linear auricles, not butterfly-shaped: one frond is auricled for  $21\frac{1}{2}$  in.

Mr. Blanford never gave *N. canum*, Baker, as other than a synonym of *N. prolixum*, and in his published paper (Journ. Asiat. Soc. Bengal, 1888) he said—"I include herewith the forms from Simla that have been referred to *N. canum*, the type of which is a specimen of unknown origin, grown at Kew, and having sub-marginal sori." (I may here remark that there are several pot plants in the Kew Temperate Fern-house ticketed *N. canum*, which are downy enough, but they have not creeping rhizomes and have stipes densely tufted as Baker's description says.) But in their joint "Supplementary Note on the Ferns of Northern India," read before the Linn. Soc., 3rd November 1887, Mr. Clarke and Mr. Baker gave "28. *Nephrodium canum*, Hook and Baker; C. B. Clarke in Trans. Linn. Soc., ser. 2, Bot., Vol. I, p. 515. Simla, H. Blanford; rhizomate horizontale brevi: sed in *N. prolixo* type. C. B. Clarke No. 44652 rhizoma omnino simile videri potest." This shows that the Simla specimen from Blanford had a creeping rhizome, because Clarke's No. 44652 has; though the entry seems intended to confirm the remarks made by Mr. Clarke in his "Review," 1880, in which he gave *N. canum* as a distinct species (No. 6) with tufted stipes—"I fear this is only a variety of *N. prolixum*." . . . . "I can find no good distinction." Mr. Clarke then gave *Aspidium appendiculatum*, Wall., as a synonym of *N. canum*, and remarked—"Of *A. appendiculatum*, Wallich collected a large series; the type sheet in his Herbarium is *N. canum*, Baker type."

Of *N. prolixum*, Baker, to which he attributed *N. canum* Baker, and *N. ochthodes*, Kze., as synonyms, Mr. Blanford wrote in an early paper, which was only privately distributed:—

"Not uncommon in ravines below 6,000 feet." . . . "It differs in some respects from the descriptions of Clarke and Beddome. The caudex is decumbent, or shortly creeping, not erect." . . . "The lowest pair of pinnae (sometimes two or three pairs) shorter, then suddenly reduced to auricles." . . . "What the *N. canum* may be, collected by Thomson and Edgeworth in the neighbourhood of Simla, unless herbaceous, glandless specimens of *N. prolixum*, I will not venture to surmise." . . . "I think it probable then that the Simla specimens of *N. canum* are simply *N. prolixum*."



It is improbable that Mr. Blanford, at the time the remarks above extracted were written, had ever seen a specimen of the N.-E. Indian *N. prolixum* with a rhizome attached ; and I conclude that, though nothing was said in the "Synopsis" about the rhizome, he believed with Mr. Clarke that the caudex was erect and the stipes tufted, and yet held that the Simla fern, with a caudex decumbent or shortly creeping, and with other differences, varied only slightly from *N. prolixum*. He does not say that it grows in isolated plants, with decumbent or shortly creeping caudices, and stipes in a tuft ; and I am confident that had he carried his investigation farther he would have found the widely creeping and branching rhizome of *N. repens* throwing up fronds at intervals, and forming a more or less extensive bed.

*N. longicuspe*, Baker, from Madagascar, seems to be *N. repens*, but the rhizome is wanting. The West African specimen cited above is, or was, in the *Nephrodium molle* bundle at Kew. The largest frond of *N. repens* I have is 4 ft. long, including the auricled base, by 10 in. br.; but a specimen in Mr. Gamble's collection, his No. 17824, from Sikkim I think, mounted on three sheets, is 6 ft. l. by 1½ ft. br., 2 ft. of that length being merely auricled, the auricles not papilionate ; the stipe is wanting. The fern is probably rare in Eastern India : Clarke's No. 44652, from Shillong, is perhaps the only representative from Assam. I have seen a few specimens of a plant, with glands at base of pinnae and papilionate auricles on the stipe, from Sikkim and the Madras Presidency, which have portions of an erect caudex, and these I think ought to be called *N. ochthodes*, Kze. (under *Aspidium*). Beddome's figure in F.S.I., t. 106, seems to be a representative of this last-mentioned plant, and it shows the papilionate auricles, though only two pairs of them. *N. repens* loves moisture, and grows by the sides of water-courses and on swampy ground below springs.

( To be continued. )

## THE FERNS OF NORTH-WESTERN INDIA,

Including AFGHANISTAN, the TRANS-INDUS PROTECTED STATES, and KASHMIR:  
arranged and named on the basis of Hooker and Baker's *Synopsis Filicum*,  
and other works, with New Species added.

By C. W. HOPE.

(Continued from page 538).

### PART III.

### NEW SPECIES.

**11. *Nephrodium Kingii***, n. sp.—*Plants* isolated? ; *caud.* erect? ; *st.* short—about quarter the length of the frond, clothed with dark brown acuminate hair-pointed scales, truncated at base ; *fr.* small—6—10 inches l, 2—3 inches br., lanceolate-acuminate, rhachises clothed with scales similar to those on stipes, but smaller ; *pinn.* up to about 18 pairs, subdeltoid, but with the inferior of the lowest pair generally rather the shorter, almost sessile, and decumbent on the main rhachis, gradually narrowing to a not acuminate apex, cut down to a broadly winged rhachis into upwards of 10 distinct rectangular bluntly-rounded segments, which are toothed round the apex and lobed on both sides—the lobes more or less toothed according to size of plant ; *texture* herbaceous ; *ven.* pinnate in the segments, veinlets in triplets in the lobes and running into the teeth ; *sori* small, subcostal, one to each lobe on the lower veinlet ; *invol.* entire or irregularly lacerate, not fimbriate, persistent. (PLATE IX.)

PANJAB : *Chamba*.—Ravi Valley, below Salrundi 95-10,000', McDonell 1882 ; Chenab Valley—Cheni Pass (Pangi side 10,000', McDonell : in Herb.-Hort. Calc. *Simla Reg.*—above Simla, Colonel Bates. N.-W.P. : *T. Garh.*—moraine of Dudu Glacier under Srikanta 14-15,000', Duthie 1883, Nos. 386 and 394.

DISTRIB.—*Asiæ* : N. E. Ind. (Him.) Sikkim, Lachen 11-12,000', *Hooker K.* 1849 ; Sundukphoo 92,000', *Levinge* 1880 ; Jongri 13,000', *Gammie* 1892, No. 187 ; Thibet—Dungboo, and Do-tho, King's Collector 1877, No. 4693.

This elegant little plant was, if I remember rightly, put up by Mr. McDonell among specimens which he sent me of my next species—*N. serrato-dentatum* ; and specimens sent by him to Gamble were named by Levinge *N. Filix-mas*, near *odontoloma* (meaning, I believe, *N. serrato-dentatum*). The segments are not nearly so much incised as those of the last mentioned plant—merely shortly toothed ; the stipes are shorter and not so thick, though stiffer ; and the rhachises are inconspicuous below, contrasting with the dark-coloured secondary rhachises of *N. serrato-dentatum*. The pinnæ are blunter, and are never nearly bipinnate ; and the venation is not so distinct.

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The serial numbers prefixed to the New Species show their place under each genus in the General List (Part III), where the names only will be repeated.

**12. *Nephrodium serrato-dentatum*, n. sp.**—*Plants isolated; caud. erect; st. in a dense tuft which attains 1½ in. diam. ; "Stipes 6 in.. soft, thick, chesnut, coloured, with scattered, deciduous, lax, lanceolate, black pales; frond 10 by 6—8 in., oblong-lanceolate, truncate at the base; pinnæ often widened at the base—2-pinnate; secondary pinnæ elliptic, oblong, obtuse, pinnatifid (sometimes deeply); segments rounded, sharply serrate; texture thin, becoming hyaline towards the margin; venation sub-flabellate; involucre fimbriate."* *Lastrea Filix-mas* var.  $\mu$ , *odontoloma*, Moore, Bedd. F. B. I., Suppt. t. 373.; *Nephrodium Filix-mas*, var. *odontoloma* (Bedd.), Syn. Fil. (2nd Ed.), 498; *N. odontoloma*, Hook. and Baker, C. R. 521. *Lastrea odontoloma* (Moor.), Bedd. H. B. 24-. *Lastrea Filix-mas*, var. *serrato-dentata*, Bedd. Suppt. H. B. 55. (Plate X.)

KASHMIR: *Liddir Valley*.—Chatponsal Nála 12-13,000', Duthie 1893, No. 13.21'; *Sind Valley*, near Baltal, 10-11,000', Duthie 1892, No. 11613 (probably so)

PUNJAB: *Chamba*—Ravi Valley—Salrundi 11,000', and *Chenab Valley*—Cheni Pass, McDonell 1882.

N.-W. P.: *T. Garh*.—Gangotri 12-13,000', Duthie 1881; Damdar Valley 11-12,000', moraine of Dudu Glacier, under Srikanta Mt. 14-15,000'; Gambar Pass 11-12,000', Duthie 1888. *B. Garh*, above Bhawani 13-14,000', Duthie 1885. *Kumaun*—Pinsara Pass 10,000', Davidson 1875; Rálam Valley 11-13,000', Duthie 1884; Byáns—Pálang Gádh 11,000', Duthie 1886.

DISTRIB.—*Asia*: N. E. Ind. (Him.).—Sikkim and Bhotan 11-16,000', "common" (*Clarke in Ret.*)—China—Hopeh Prov., Dr. Henry 1889.

The quoted part of the description given above is Mr. Clarke's, representing, as he says, the fairly developed average, though he had examples much larger. The plate in Beddome's Suppt. to F. B. I., t. 373, was, Mr. Clarke says, drawn from a high-level scrap, and the description in the *Synopsis*, 2nd Ed. p. 498, seems to have been written from that scrap, which is even more unlike *N. F.-mas*. than are the fairly developed fronds which Mr. Clarke afterwards (?) contributed to the Kew Herbarium, some of which run to fully 13 inches in length; 6—7 inches is, however, the greatest breadth I see there. I have incomplete fronds collected by Dr. T. Thomson in Sikkim (?) which measure 16—17 in. l., but they are not more than 6—7 in. br. These and some smaller fronds were named by Dr. Thomson (?) *Nephrodium Brunonianum* var., but are unlike that species. I would modify Mr. Clarke's description by saying that the pales are dark to pale chestnut; that the segments are not serrate—only toothed so as to enclose the veinlets; that the venation is very distinct; that the sori are one to each of several of the lower lobes of the segments or pinnules, placed near the costa. Also that the secondary pinnæ are never stalked, but have a broad base getting narrower near the main rachis. The upper half or more of each pinnæ is only bipinnatifid. Many small





N. E. Brown del.

A. C. Mukerjee lith.

NEPHRODIUM KINGII, n. sp.

1. Frond, natural size.
2. Base of another frond, natural size.
3. Base of a pinna,  $\times 3$ .
4. Sorus with indusium,  $\times 10$ .
5. Two indusia,  $\times 10$ .
6. Scale from the stipe,  $\times 5$ .
7. Part of a scale from the stipe,  $\times 30$ .





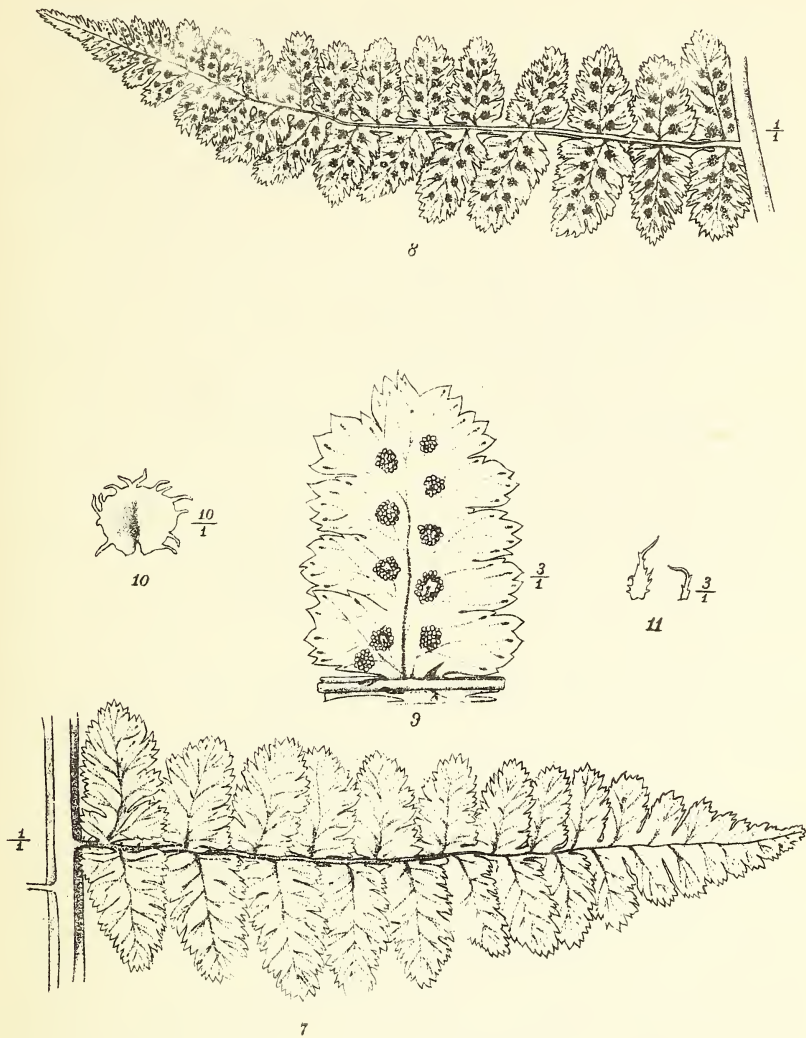




N. E. Brown & A. L. Singh del.

# NEPHRODIUM

1. Rhizome of a large plant, natural size.
2. Portion of a small plant, natural size.
3. Basal part of a pinna of another frond underside,  $\times 3$  diam.
4. Two indusia.  $\times 10$ .
5. Scales from the base of the stipes,  $\times 3$  diam.
6. Scales from upper part of the stipe and frond,  $\times 3$  diam.



**SERRATO-DENTATUM. n.sp**

A.C. Mukerjee lith.

- 7. Lower barren pinna from a large frond, upper side, natural size.
- 8. Fertile pinna from the same frond, underside, natural size.
- 9. Pinnule,  $\times 3$  diam.
- 10. Indusium,  $\times 10$  diam.
- 11. Scales from middle part of the frond,  $\times 3$  diam.





young (?) fronds are not even deeply pinnatifid, *e.g.*, the frond figured by Bedd me.

In his Handbook Colonel Beddome followed Mr. Clarke and separated this fern from *N. Filix-mas*. Mr. Clarke did not think it ran into any form of *N. Filix-mas*, and pointed out that the venation was very unlike the forked venation of that species. But Colonel Beddome, in his latest Supplement, says—“This is certainly only a variety of *Filix-mas*.” As no reasons are given for this ruling, and as it is against the evidence of my senses, I must consider it as an *obiter dictum*, and decline to be bound by it. In a preliminary list, drawn up in 1891, but not published, I re-named this fern as *Nephrodium incisum*; but I must now adopt Beddome’s specific name.

**15. *Nephrodium pandum*, n. sp.**—“Stipes round, firm” (long: sometimes longer than the frond); “frond nearly glabrous beneath, the main rhachis with a few ovate scales; frond narrowly oblong, the lowest pair of pinnae but one often as long as any above, the lowest pinnae usually but little shorter; pinnae pinnatifid  $\frac{1}{3}$ — $\frac{2}{3}$  the way to the midrib; segments subspinulose, serrulate.” *N. Filix-mas*, Richd., var. 1 *panda*, C. B. Clarke.” Plate 68, C. R. 519, fig. 1. *Lastrea Filix-mas*, var. *panda*, Bedd. H. B. 251, and Suppt., p. 56.

PUNJAB: *Kangra Valley Dist.*—Dharmasala 10-11,000', C. B. Clarke. N.-W. P.: *T Garh.*—Kidarkanta Mt. 8000', Herschel 1879; Ganges Valley, above Jhāla 11-12,000', Duthie 1831. *Brit. Garh.*—East of Dhakwāni 11-12,000', Duthie 1885. *Kumaun*—Gori Valley between Paton and Saba 7-8,000', Duthie 1884.

DISTRIB.—N. E. Ind. (Him.)—Sikkim 9-10,000', *J. D. Hooker*.

Mr. Clarke says—“Some of the European var. *cristata* approach thi-.” It does not appear whether he refers to the cultural variety of *N. Filix-mas*, or to *N. cristatum*, Michx. Beddome’s first thought was—“This has much the aspect of *odontoloma*” (meaning, evidently, *L. odontoloma*, Moore), “and it will probably prove to be a luxuriant form of that plant.” His second thought expressed in the Supplement of 1892, was—“There are specimens at Kew which are intermediate between this variety and *Schimperiana*.” Second thoughts are proverbially the best. I can find no good distinction between *N. pandum* and *N. Schimperianum*, and retain *N. pandum* chiefly out of deference to Mr. Clarke who has gathered both plants. I have not gathered the first named. *N. pandum* might be called a long-stiped and comparatively glabrous form of the Indian plant which is called *N. Schimperianum*, Hochst., and Mr. Clarke says that the less compound forms of var. *Schimperiana* ran near var. 1 *panda*. Perhaps the best reason for retaining *N. pandum* as a species is that it is more unlike *N. Filix-mas* than *N. Schimperianum* is. Mr. Bliss’s

specimen of the last-mentioned fern, from below Haripur, near Simla, at a low level I think, might almost be transferred to *N. pandum*.

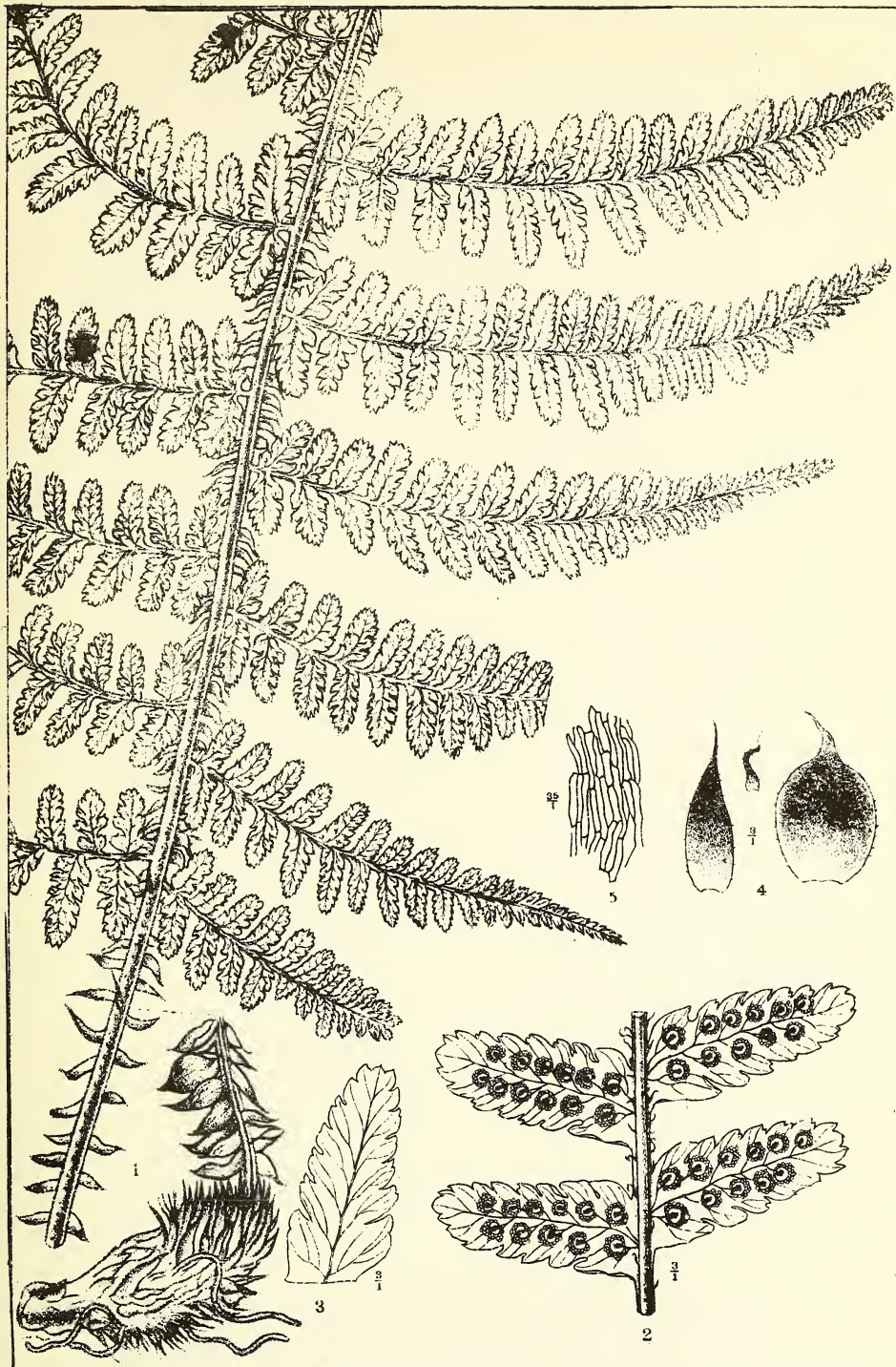
I give the "distribution" to Sikkim with hesitation, as the stipes of Sir Joseph Hooker's specimens are incomplete, and there are more veins in a segment than the N.-W. Indian specimens have. Of these (?) Mr. Clarke says—"Sir J. D. Hooker collected at Lachen in Sikkim, alt. 9-10,000', a fern which seems a luxuriant form of *panda*."

**18. *Nephrodium Blanfordii*, n. sp.**—*Plants* isolated; *caud.* suberect; *st.* in a tuft. generally short, wiry, densely clothed at base with long narrow bright chestnut scales, and higher up with broadly, ovate, acuminate, and lanceolate-acuminate, particoloured scales, both sorts truncate at base; *fr.* 1—2 ft. l., 6"—12" br., lanceolate, truncate though somewhat narrowed at the base, bipinnate; main rhachis clothed with lanceolate-acuminate, particoloured scales, mixed with fibrillæ: secondary rhachises fibrillose; *pinn.* about 25 pairs, distant, but not more so towards base of frond, patent, linear-acuminate, broadest at base, cut down to a narrowly winged rhachis into 12—14 pairs of sessile broad-based pinnules set widely apart, having a confluent acuminate toothed apex; *pinnl.* oblong, bluntly rounded, divided more or less deeply into 4—6 slightly-toothed lobes; *texture* herbaceous; *ven.* costa of pinnule undulating and branching into the lobes; veins branching into 2—4 veinlets in the lobes; *sori*—one on each lowest superior veinlet of a group, near the costa, confined to upper part of the frond. (Plate XI.) *Nephrodium* (*Lastrea*) *remotum*, Blanf. in Journ. Asiat. Soc. Bengal, Vol. LVII, Part II, No. 4, 1888.

KASHMIR: Nagmarg and Sonamarg, 85-9000', Trotter 1888. PUNJAB: *Hazara Dist.*—Kagan Valley 94-10,200', Duthie's collector 1896-97; Dunga Gali 7-7500', Trotter 1889; Chamba 6100', J. Marten 1897; *Simla Reg.*—Ridge east of Simla, Kamalhari Mt. 9500', Blanford 1885; "Common about Nágkanda at elevations between 8300' and 9500'; Nágkanda to Bági 82-8500', Hope 1886; Biáhir—Sdeeling 9000' Lace N.-W. P.: *T Garh.*—Ganges Valley above Jhála 11-12,000', Duthie 1891.

I give the fern entered in Blanford's List as *Nephrodium remotum* as a synonym of *N. Blanfordii*, because, having received from him specimens named *remotum*, which are exactly the same as those I collected in the same locality, at about the same time, I know that in his paper of 1888 he wrote of the same fern as I now do. But the plant is in no way near *N. remotum*, Hook. (not of Clarke, as Mr. Blanford quotes it), and must therefore be re-named. Mr. Blanford, who, when he wrote, had not, I believe, much studied European ferns, said—"I adopt Mr. Clarke's name for this fern, without implying acquiescence in the view that it is identical with the European prototype." He had previously, under his No. 66, *N. Filix-mas*, var. *marginata*, Wall., said that





N. E. Brown. del.

*NEPHRODIUM BLANDFORDII*, n. sp.

Lith: by K. D. Chandra.

1. Portion of a rhizome & part of a frond.
2. Part of a pinna, undersurface, enlarged 3 diam.
3. Pinnule without sori, enlarged 3 diam.
4. Scales from the stipes, enlarged 3 diam.
5. Cells of the central part of a scale enlarged 35 diam.





there was an interval of 2,500 feet between the upper limit of that species and the lower limit of what he called *N. remotum*, and discussed the differences between those two ferns, arriving at the conclusion that altogether they indicated specific distinction. I cannot see even the remotest resemblances between them. *N. Blanfordii*, though there may be thought to be some similarity in the details of cutting, does not, as a whole, suggest the European plant, the pinnæ of which, as its name denotes, increase in distance downwards until they are three inches apart at the base; whereas in the Himalayan plant the lowest pinnæ are not more "remote," and it is smaller than the British plant which, like the Continental European one, is believed to be a hybrid between *N. F.-mas.* and *N. spinulosum*, Desv. Mr. Barnes, of Beethwaite Green, Westmoreland, who long ago gave me a frond of *N. remotum* from an original plant received from Mr. Clowes, of Windermere, the discoverer of the so-called species, told me he believed it to be the above indicated hybrid, and that he had found that its spores produced typical *F.-mas.* I demur entirely to Mr. Clarke's statement that the typical plant figured by Hooker, Brit. Ferns, t. 22, is frequent in the West Himalaya, as I cannot find that it at all exists there. When gathering the two plants in the Simla Region I did not at first separate, except by size, *N. Blanfordii* from *N. ramosum*, Hope (in *Journ. Bot.*, March 1896); but I afterwards saw that they differed in shape and cutting of the fronds. *N. Blanfordii* is near *N. F.-mas.*; but it has no affinity to *N. spinulosum*, Desv., which has not been got in the Indian Region. In the *Journal of Botany*, under *N. ramosum* I said—"Perhaps the nearest congener of this species is *N. nemoralis* (a slip or misprint for *N. nemorale*), n. sp., Hope MS., a fern with a more limited range, hitherto called *N. spinulosum* Desv., var. *remota*; but that species is never truly bipinnate, and it has always a short stipe and dark-coloured scales." When I thus wrote (in India), I was imperfectly informed as to the accepted meaning of the term "bipinnate." Also I have, in publishing, altered the specific name of this fern, because "*nemorale*" was thought to be too near that of a previously described species; and I can find none more appropriate to it than one that will commemorate the name of the late Mr. H. F. Blanford.

Subgenus—*EUNEPHRODIUM*.

**29. *Nephrodium Papilio*, n. sp.**—*Plants* isolated; *caud.* erect: in old plants subarborescent; *st.* numerous, stout, rising regularly from round the apex of the caudex, very short, almost glabrous; *fr.* lanceolate, generally suddenly contracted to a long deeply pinnatifid apex or terminal pinna and always prolonged downwards, with shorter and shorter auricled pinnæ, nearly to the

caudex :  $1\frac{1}{2}$ —5ft. l.,  $4\frac{1}{2}$ —14in. br., the auricled short pinnæ occupying the lower 4—20in. ; *pinn.* 15—40 and more pairs (including those auricled) according to size of frond, narrow, rarely more than  $\frac{3}{4}$ in. broad, not much diminished in lower half, above gradually narrowing and ending in a very acuminate apex ; cut down  $\frac{1}{3}$  to nearly  $\frac{1}{2}$  way towards the rhachis, increasingly distant and becoming more opposite towards the base of the lanceolate portion of the frond where they suddenly shorten, become almost exactly opposite and deflexed, and throw out auricles upwards, which lengthen as the pinnæ shorten and become pinnatifid lower down, with separate costæ ; *segm.* of pinnæ curving upwards, broadly falcate, subentire, connected at the sinus by a hyaline web which extends towards the rhachis of the pinna over one or even two inter-venal spaces ; *texture* papyraceous ; *surfaces* practically glabrous : *rhachises* sometimes slightly villose or pubescent above, and occasionally with a few white hairs or setæ on the veins above ; *ven.* simply pinnate—veins 7—8 pairs to a segment,  $1\frac{1}{2}$ —3 pairs uniting with those of continuous segments : an excurrent veinlet from the lowest pair free or sometimes joining only one of the next upper pair, and occasionally also another one or two before it reaches the sinus ; veins of the auricles branching in the shallow lobes, and uniting with those of the contiguous lobes when the auricles are more deeply pinnatifid ; *sori* small, medial on the veins, absent from the apices ; *invol.* fugacious or shrivelling on top of the ripe sorus. (Plate XII).—

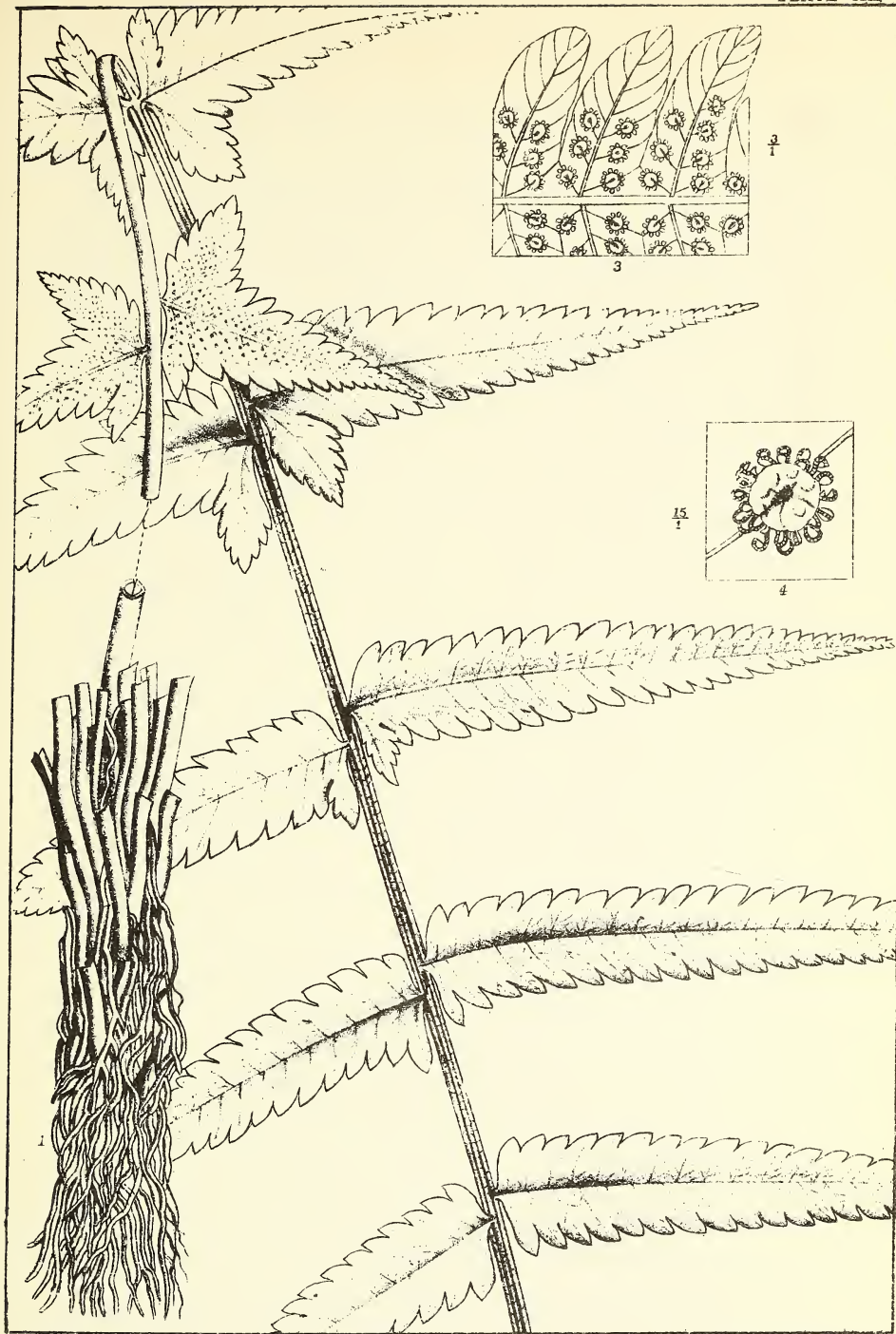
*N. molle*, Desv., *var. major*, Bedd. Suppt. H. B. 76, in part.

PUNJAB : *Chamba*, McDonell (in list of Chamba Ferns identified at Kew, named *N. amboinense*). *Simla Reg.*—Simla, 5th Waterfall, Collett 1883, Samāla Nāla 4500 Blanf. 1884 (under *N. pennigerum*, Hook. *var. multilincata*, Wall. : it “occurs, together with *N. molle*, at the lowest levels visited below Simla (4500’), and I have it also from Mussooree, collected by Mr. C. W. Hope, and from below Chakrata ;” Simla—between 2nd Waterfall and Boileauganj, Bliss 1890.

N.-W. P. : *D. D. Dist.*—In the Dun, near Malsi, and in the Song Valley near its exit from the Himalaya 26-2800’, Hope 1887-89 ; Mussooree—Duthie 1887, below Khiarkuli 4700’, Hope 1880, Colonel Herschell 1878 or 1879, Mossy Falls. 5500, Hope (with Duthie) 1882, below Arnigadh 5000’, Duthie 1882 : *T. Garh.*—Surkunda Mt. 9300 Lev. 1872 ; north of Mussooree 3000’, Mackinnons 1879 ; near Bhatauli 4500’, Hope 1886 ; Thadiar 3500’, Gamble 1894. *Kumaun*—S. and W. No. 2 ; Gola Valley : seen in 1890 in cultivation at “Douglas Dale” 4500’, brought from neighbourhood.

DISTRIB.—*Asia* : N. Ind. (Him.)—Nepal, Wallich, 1829. Sikkim—Pootsering below Darjeeling 4000’, Lev. 1880. Ceylon, Thwaites C. P. 2498 (named *N. Hookeri*) and Ambāwala (or Ambawella), G. Wall. “Indian Archipelago,” Seemann—“*H. Brown*, iter Austral. 1800-5.”

I long ago named this species *N. papyraceum*, but that name has since been given by Colonel Beddome, in his Supplement of 1892, to a



N.E. Brown del.

A. C. Mukerjee lith.

## NEPHRODIUM PAPILIO, n. sp.

1. Part of a rhizome, natural size.
2. Part of a frond, natural size.
3. Part of a pinna, under surface,  $\times 3$ .
4. Fragment of a pinna, showing a sorus with the indusium,  $\times 15$ .





species of his own making, some of which, I have good reason to believe, is only *N. arilum*, Baker (q. v.). The only resemblance it has to *N. molle*, Desv., of which Beddome says it is a variety, is in cutting and venation; in every other character it is different. It is a very handsome plant, with fronds rising in a ring round the apex of the subarborescent caudex, forming an inverted hollow cone like that produced in *Struthiopteris germanica*. *N. molle* does not grow so regularly. Other distinguishing characters are—the thin papyraceous texture; the almost glabrous surfaces; the prolongation of the frond down the shaft below the lance-head, so to speak; in short, broadened and auricled pinnae, in almost exactly opposite pairs, which irresistibly suggest butterfly's head downwards—the main rhachis representing the body; and, finally the fugacious or inconspicuous involucre. I have seen this fern in cultivation in the irrigated garden at “Douglas Dale,” below Naini Tal, and consider it a strikingly beautiful plant. It seems to require wet, or occasionally flooded, ground for its full development, and consequently the caudex and stipes are naked, or nearly so. Mr. Levinge noted, regarding the specimens he collected below Darjeeling, and which he incorrectly named *N. truncatum*, Presl., that the plant grows 6—8 ft. high. Mr. Duthie and I got it more than 5 ft. high in a swampy patch in forest near Mussooree in 1882; but I could never find the spot again. *N. molle* is one of the commonest ferns in the Dehra Dun, and the outer N.-W. Himalaya at low levels, and it, too, likes water; but it is never glabrous, and never has the butterfly-auricled pinnae extending down the shaft of the lance.

Colonel Beddome, in his Supplement of 1892, says—“Mr. Hope considers this a well-marked fern, and says that it is subarborescent, and of a brilliant green colour” (I don't recollect giving it the latter-mentioned character); “his specimens have quite an erect caudex; Mr. Wall's Ceylon specimens however, have a decidedly creeping root”. . . . “it is a most marked fern when fully auricled nearly down to the base of the stipe, but I find this is not always constant, as I have specimens which run *molle* rather close.” I have since seen the Ceylon specimens Colonel Beddome referred to—two fronds with creeping rhizomes: the fronds are similar, though they have only 5 pairs of auricled pinnae; but the creeping rhizome I consider quite enough to separate them, not only from *N. Papilio*, but also from *N. molle*. Thwaites's and Wall's specimens in Kew, cited above, have not a scrap of rhizome: otherwise they are *N. Papilio*.

**30. *Nephrodium occultum*, n. sp.**—*Caut.* (or *Rhiz.*) not seen; *st.* 14½—36 in. (incomplete) in length, slightly palaceous at base, as shown by scars of fallen scales; *fr.*—of small specimen 19½ in. l., 10 in. br.; of larger

specimens—34½—36 in. l., 15 in. br., truncate at base—lowest pinnæ being almost as long as any, pinnatifid; *pinn.* 13—21 pairs with a large pinnatifid and slightly toothed terminal pinna, sessile, up to 9½ in. l., ¾—1¼ in. (nearly) br., linear, acuminate, curving upwards, lowest 2—3 pairs which are patent or deflexed, cut down half-way into numerous (35—45) narrow curved falcate entire, or slightly crenate, segments of irregular length with a terminal tooth—the superior basal segment generally much longer, and the inferior much shorter, than those above: *texture* papyraceous but not membranous, whole plant perfectly glabrous, except for a slight pubescence on upper side of sec. rh.; *colour* of lamina brown-green; of stipes and prim. rh. pale brown tinged with pink, cf sec. rh., perhaps pinker; *ven.* obscure on upper side; on under side distinct, costæ of segments coloured like sec. rh., veins very slender, 8—13 pairs, according to size of frond; sometimes 15 pairs in superior basal segment and only 5 pairs in corresponding inferior segments, lowest pair uniting at an obtuse angle with the lowest veins of the contiguous segments, whence an excurrent venule arises, sometimes free, or, if ascending to the sinus, joined by 1—2 more pairs of veins curving upwards from the adjacent segments; *scri* not seen. (Plate XIII).

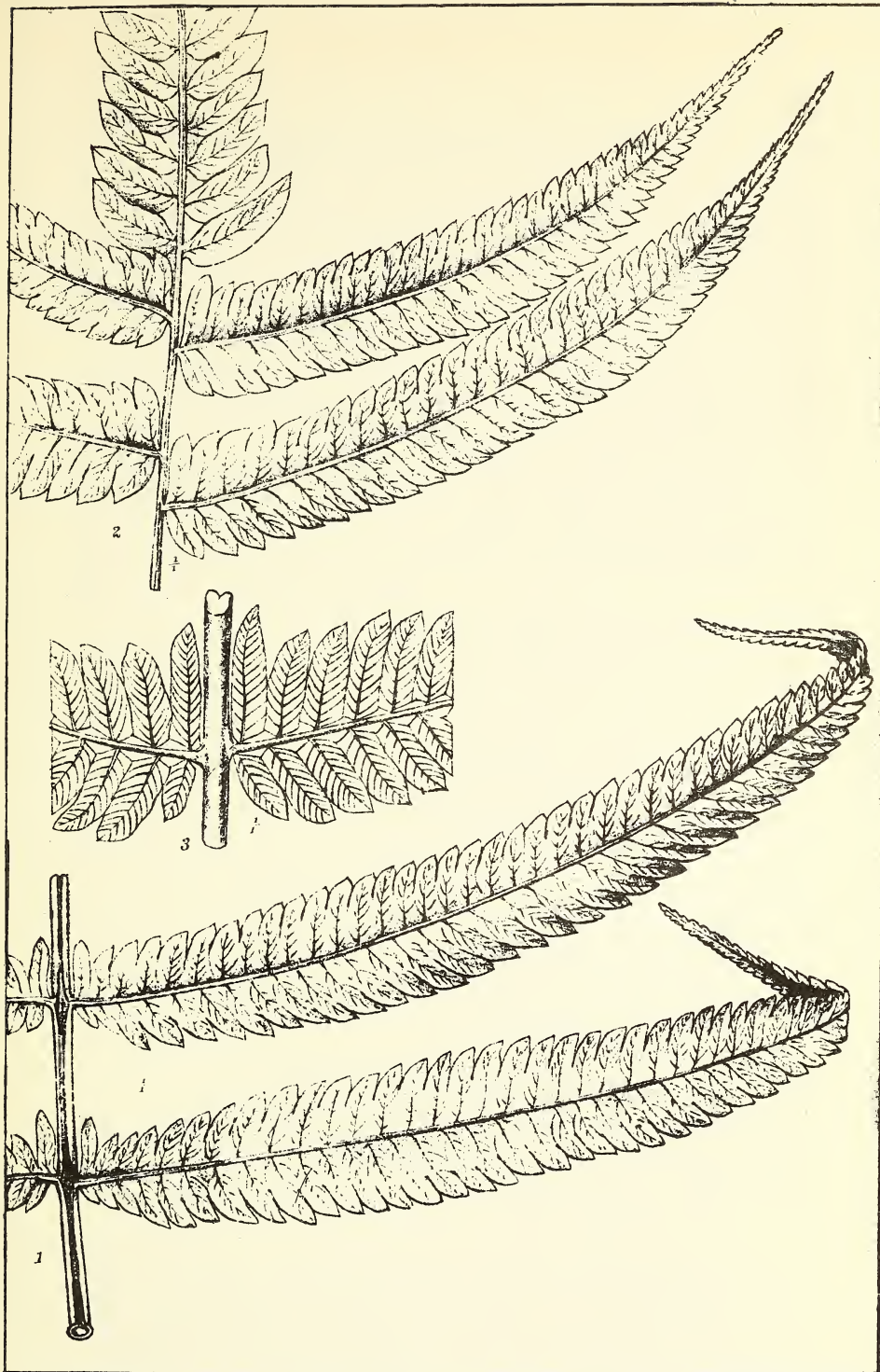
N.-W. P.: Tehri Garhwal (?) Found by me, in 1890, in the Mackinnons' collection, without tickets: 2 large and 2 small fronds.

The Mackinnons could give no account of this fern, and it may have been gathered by their collector when apart from them—probably fifteen years before I saw the specimens. None of the fronds were fertile; there was no caudex or rhizome, and the stipes of the larger fronds were not complete; but I have no doubt the genus is *Nephrodium*. This must be a striking looking fern, standing at least 6 ft. high, with a stipes as long as the frond.

#### Genus 26—POLYPODIUM, L.

##### Subgenus—PHEGOPTERIS, Fée.

5. *Polypodium late-repens*. n. sp.—Trotter MS.—“*Rhiz.* widely creeping and branching, dark purple, furnished with numerous fibrous rootlets and acute light brown scales. *St.* 1—2 ft. long, scattered, dark purple and curved at the base, becoming light brown or straw-coloured above; stipe and rhachis more or less scaly, glossy, furrowed when dry. *Fr.* lanceolate, 20—30 in. l., 8—12 in. br. at widest part, subbipinnate. *Pinn.* 20—30 pairs, distant below, but approximate towards apex of frond, lowest pair often reduced, sessile, 4—6 in. l., 1—1½ in. br. at base, tapering to a point, patent to erect, cut down nearly or quite to the midrib into decurrent, oblong, blunt pinnules



N. E. Brown. del.

## NEPHRODIUM OCCULTUM, n. sp.

Chitra Silpi C<sup>o</sup> lith.

- 1 Portion of the base of a small sized frond, natural size.  
 2 Portion of the apex of ditto, showing the abrupt termination in a large pinna; natural size.  
 3 Basal parts of two pinnae from the middle of a large frond, natural size.





$\frac{1}{4}$  in. wide, margin acutely or crenately lobed; *texture* herbaceous; under surface hairy; *ven.* pinnate in segments, free. *Sori* naked, medial, orbicular, terminal on veinlets, usually one, sometimes two or three to each lobe." (Plate XIV.)

*Remarks by Mr. Trotter.*

"This fern is not uncommon in the Western Himalaya, at an elevation of 7-9,000'. I have specimens from Kumaun and Garhwal, and have personally collected it at intervals from Simla to Hazara, where it is abundant, forming extensive patches. It seems to connect *Polypodium distans*, Don, with *Gymnogramme aurita*, Hook., combining the frond and sori of the former with the rootstock and stipes of the latter; and when collected without rhizome it has frequently been mistaken for *P. distans*, from which in that mutilated condition it is not easily distinguishable.

"Its wide-reaching rootstock and scattered stipes, bent round at the base, are such well-marked characters as to entitle it, I think, to rank as a good species."

KASHMIR : Chittapani Valley and Rattan Pir, 75-8000', Trotter, 1888; Dardpora 4-6000', MacLeod 1891.

PUNJAB : *Hazara Dist.*—Thandiana and Dungagali 75-8500', Trotter 1890-92; Kagan and Siran Valleys 9000', Duthie's collector 1896. *Chamba*—5-8000', J. Marten 1897. *Kangra Valley Dist.*—Dharmasala 8000', Trotter 1887; *Simla Reg.*—below Simla 5500', and Jako Mt. 7700', Blanford, 1886; ridge east of Simla, Maihisu (Mahasu), 7500' and spur north-west of Nágkanda, 8200', Hope 1886; Battu Mt. 9-10,000', Gamble 1878, Collett 1885; Bági 9400', Bliss 1891.

N.-W. P. : *D. D. Dist.*—Jaunsar, (or T Garh. : ticket incomplete), Gamble; Seal's Hill—East of Landour, 7000', Hope 1887 and 1895; *T. Garh.*—Nag Tibba Mt. 7500', Mackinnons 1879; near Bhatauli 4500', Hope 1886; Phedi—East of Landour—5-6000', Duthie 1881. *Kumaun* 7000', S. and W.; Durasu 6000', Davidson 1875; forest above Shankala 9-10,000', Duthie No. 3712; Sarju Valley 3-4000', and Dhankuri 9,000', Trotter 1891.

DISTRIB.—*Asia* : N. Ind. (Him.).—Nepal; Sikkim (?).

The only previously described plant which may possibly be this is *Polypodium paludosum*, Bl. Fil., Jav., p. 192, t. 90; but Blume's plate shows only the upper part of a frond—14 pinnæ, a short tip, and an enlarged pinnule. Blume says—"Frond, 4-5 ft.; caudex," so far as he recollects, "repens, stipites efferens plures remotos."

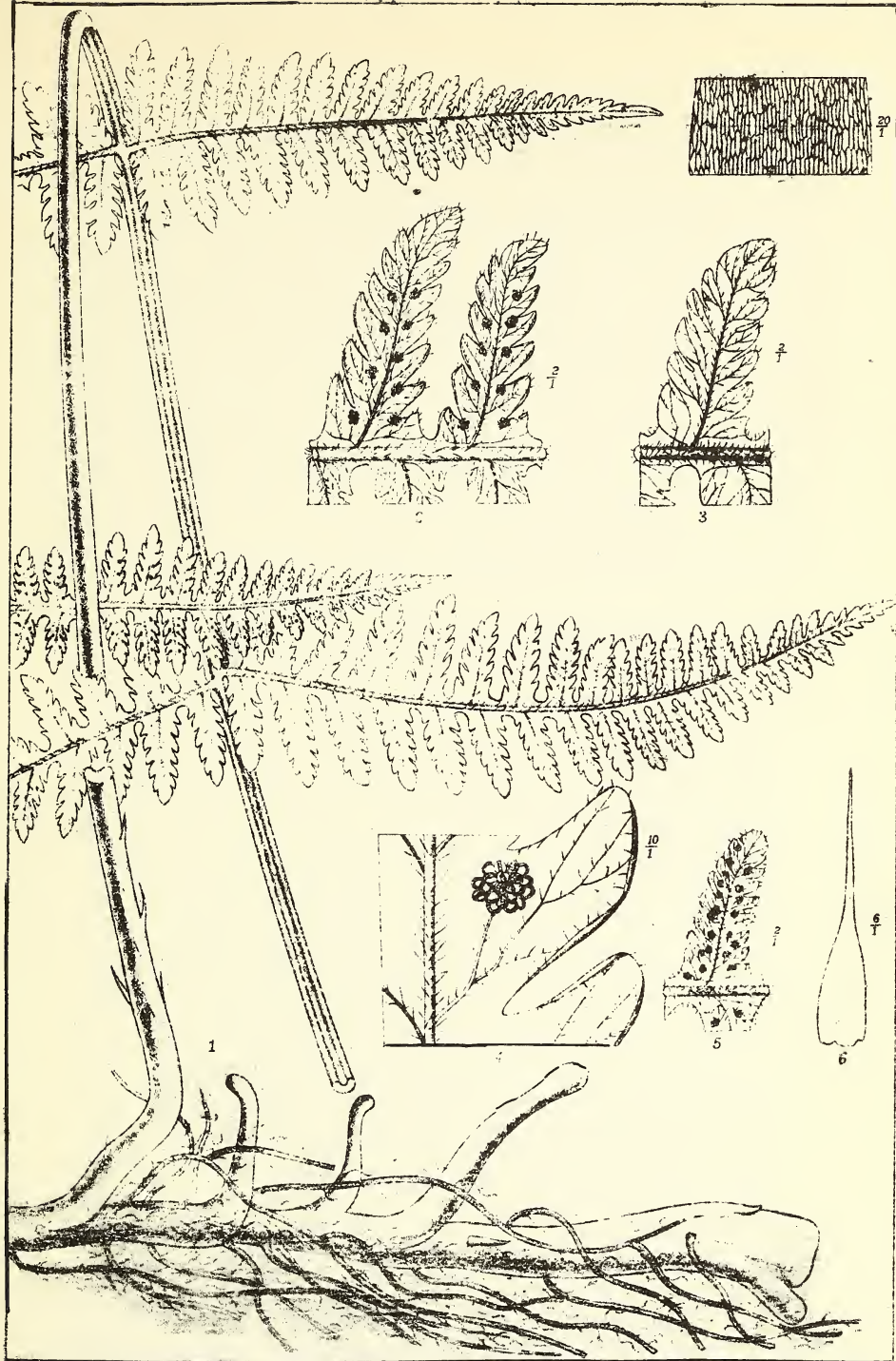
Beddome, in his "Ferns of S. India," p. 55, t. 168, said of *P. paludosum*—"Caudex short, erect, covered with scales at apex." He did not give *P. distans* as a synonym; but in his Handbook, p. 292, he dropped *P. paludosum* as a species, and gave it as a synonym of *P. distans*, Don—referring to his F. S. I. t. 168. For *P. distans* he wrote a new and elaborate description (Don's being, as usual, short and incomplete), and said of it—"Stipe tufted." Don did not

mention the nature of the caudex or rhizome. As synonyms, Beddome gave in the H. B. the three names he had given for *P. paludosum*, namely, *P. brunneum*, Wall. Cat. 333, *P. longipes*, Wall. Cat. 316, and *P. adnatum*, Wall. Cat. 328; and he added a fourth, *P. Griffithii*, Hook. Sp. Fil. IV, 236. Mr. Clarke gives *paludosum* and *longipes* as synonyms of *P. distans*, and resuscitates *P. adnatum* as a variety of it, and he gives *P. brunneum* as a synonym of *var. adnata* (sp.), Wall., besides creating two other new varieties. Of *P. distans* he said—"Stipes tufted."

Hooker, in *Sp. Fil.* IV, p. 244, did not give *P. distans* either as a species or as a synonym of *P. paludosum*, and as to the caudex of the last named plant merely said—"caudex?". The *Synopsis Filicum* says nothing as to the caudex of *P. distans*, for which it gives *P. paludosum*, Bl., as a synonym along with *P. Griffithii*, Hook., of which it is said that it appears to be a form with subentire lobes. Clarke said of *P. distans*—"Very difficult to distinguish from *Gymnogramme aurita*, Hook." (which has an extensively creeping rhizome) . . . "the rhizome is rarely present in herbaria;" and he noted that Beddome, in his Suppt. F. B. I. of 1876, p. 24, doubts if *G. aurita* is more than a form of *P. distans*. And Clarke went on to say—"the rhizome is very different," which I think may be taken to imply that he knew that *P. distans* had an erect caudex or rhizome. By the time he published his Handbook, Beddome seems to have become satisfied of the generic distinctness of the two plants.

So much for the books I am reviewing. I will now deal with the specimens in the principal public herbariums in the United Kingdom. In the Kew Herbarium, a specimen, named *P. distans*, collected by Jacquemont, which otherwise is *P. late-repens*, has no rhizome, but the base of the stipes is curved upwards, as if it sprung from a horizontal rhizome. Other specimens in Kew with erect caudices will be found referred to above under *P. distans*. Some of them collected by Mr. Clarke show well the erect caudex and tufted stipes of *P. distans*, and his *var. minor*.

In Wallich's collection, in the Linnean Society's Herbarium, there are specimens of the three species, which have been treated by our authors as synonyms for *P. distans*. Of *P. brunneum* Wall. Cat. 333, specimens from Kumaun, R. B. 1827, and Wallich, Napalia 1821, though they are without caudices, I should from their cutting put under *P. distans*. The next sheet, I should say, is certainly large *P. late-repens*; the stipe is nearly complete, but there is no rhizome: it is ticketed "*Polypodium* doubtful," but has been numbered in pencil 333. *Polypodium longipes*, Wall. Cat. 316, Napalia 1821, though there is no rhizome, is certainly *P. late-repens*. "*P. adnatum*, Wall. in Herb. 1823, Napalia 1821," is very large *late-repens*.



N. E. Brown del.

A. C. Mukerji lith.

**POLYPODIUM (PHECOPTERIS) LATEREPENS, Trotter.**

- |   |  |
|---|--|
| 1. Rhizome and part of frond, natural size.       | 4. One lobe of a pinnule, $\times 10$ .                    |
| 2. Two pinnules, under surface, $\times 2$ .      | 5. Pinnule of a more unequally divided frond, $\times 2$ . |
| 3. A pinnule upper surface, $\times 2$ .          | 6. Scale from stipes, $\times 6$ .                         |
| 7. Fragment of a scale from stipes, $\times 20$ . |  |





The specimens in the British Museum, South Kensington, confirm the above generally, and a specimen on a sheet marked *P. distans*, E. Ind. Coll. H. and T., Sikkim, No. 17a, has a bit of creeping rhizome attached to the frond, which of course I call *P. late-repens*. Another sheet, with ticket—"61 *Polypodium paludosum*, Bl., collected by Mr. Richard Oldham, 1564, Yamsay Formosa, reed. Apl. 66"—shows moderate sized fronds, 9—10 stipes in a fascicle, with the base of one thicker stipe; but the cutting is of *P. late-repens*. The specimens on other sheets, named "*P. longipes*, Wall. 316, Napalia 1824," "*P. brunneum*, Wall., Kumaun R. Blinkworth," and "*P. adnatum*, Wall., Napalia" (his own ticket), are, in my belief, *P. late-repens*. Pinned to a sheet of "*Phegopteris brunea*, J. Smith (Wall.): synonym—*Polypodium paludosum*, Bl., Hook. Sp. Fil. 4, p. 244; Ind. Coll. H. and T., Nilgheri Mts., in. 15," is a note by J. Smith as follows:—

Obs.—With regard to *Polypodium brunneum*, Wall.: *P. adnatum*, Wall., *P. longipes*, Wall., I never could satisfy myself as to whether they were distinct species, or only states of one species. I have seen no specimen showing their mode of veneration. I am inclined to consider that there are at least two species. In the *Sp. Fil.* Sir W. J. Hooker has placed them as synonyms of *Polypodium paludosum* of Blume. It is, however, probable that Blume's plant will be found distinct; but this must depend upon future observers in collecting the specimens, and to particularly note their mode of growth (*sic*). Sir W. J. Hooker has described a new species which he calls *Nephrodium (Lastrea) microstegium*; consequently an indusiate species, of which he has seen only one specimen of H. and T.'s from India. This appears to be the same as the two sheets here marked\*; and what is singular, no indusium is shown on the plate. And as Wallich and myself have seen no indusium, I am inclined to believe it is a mistake; but at the same time it is quite possible that in a young state seen alive indusiae may be detected.

"If all are one, the synonymy will be thus—that is, supposing that Blume's name has the priority.

*Phegopteris paludosum*, J. Smith.

*Polypodium paludosum*, Blume, Fil. Jav., t. 90.

*Polypodium* § *Pheg. paludosum*, Hk. Sp. Fil. 4, p. 244.

*Aspidium paludosum*, Bl. En. Fil. Jav., p. 168, according to Mett.

*Polypodium longipes*, Wall. Cat. 314 (316?).

*Polypodium adnatum*, Wall. Cat. 328.

*Polypodium brunneum*, Wall. Cat. 333.

? *Nephrodium microstegium*, Hk. Sp. Fil. IV., 119, t. 250. Ceylon, Gardner, No. 1151, V. S. Throughout India, Wall., Hook. and Thoms.

“What can *Griffithii* be?” (This query is added in pencil.)

Finally, in the Levinge collection, in the Museum of Science and Art, Dublin, I have found a specimen, named *P. distans*, Don, from Garhwal, Levinge 1872, but on the ticket of which Mr. Levinge has written—“rootstock creeping widely.” The frond of this specimen measures 4 ft. by 15½ in., but no stipes has been preserved. On the other hand, see Mr. Levinge’s specimen with “tufted rootstock,” cited by me under *P. distans*.

Mr. Trotter and I, after corresponding in India on the subject of this fern (see his remarks above), in the end agreed that it was a *Polyodium*, and, from its peculiar rhizome, entitled to specific rank. I asked Mr. Trotter to describe it, and in June 1891 he sent me the description given at the outset of this article. He said the description had been prepared, after repeated examination, to cover every single specimen in his collection. I have given it almost *verbatim*.

*P. late-repens*, like *Nephrodium repens*, Hope, is a lover of water, and I collected it first from swampy ground near Simla, where it was flourishing on a muddy, shaly talus. The rhizome and stipes were very succulent and brittle, and, with the scales, beautifully coloured—rather, perhaps, mauve than dark purple, as Mr. Trotter has it. The size and cutting of the fronds depend, of course, on the degree and luxuriance of growth of the plant. The sori are often oval. Hooker’s remark that the frond of *P. paludosum* is invariably bipinnate does not apply to *P. late-repens*, the segments (or pinnules) of which are almost invariably united at the base, or decurrent on a winged rhachis (only in one of my numerous specimens does the wing appear to be interrupted); but at first sight some other specimens seem bipinnate. Blanford seems to have known the two plants, but yet to have placed them both as *P. distans*. He said :—

“Common in ravines, down to my lowest level (4500’), and up to nearly 10,000’. At the former limit the fronds are small and narrow, with short, distant pinnæ, and the rootstock decumbent, hardly creeping. Above 7500’ the fronds grow to 3 and 4 feet in length, broadly lanceolate, and with close-set pinnæ 2 inches broad; the pinnæ cut down square to a winged rhachis, segments deeply pinnatifid. Some specimens of these latter have a creeping rhizome.”

Something might be inferred as to the nature of the plant named by Don, *P. distans*, if we knew with certainty what the specific name meant—whether

it applied to the distance between the pinnae or to the distance between the fronds ; but, as Don does not mention the venation, and says—“*pinnis distantibus*,” I think it may be concluded that the name refers to the pinnae. Whether the present fern ought to be called *P. paludosum*, or by one of Wallich's three or four names, is a point that perhaps may never be settled ; but that it is distinct from *P. distans*, Don, cannot, I think, be questioned. In the difficulty Wallich created by not attending to the nature of the rhizome, and by giving so many names to his specimens, it seems advisable to give a new name to those that cannot reasonably be put under *P. distans*.

(To be continued.)





## THE FERNS OF NORTH-WESTERN INDIA,

Including AFGHANISTAN, the TRANS-INDUS PROTECTED STATES, and KASHMIR:  
arranged and named on the basis of Hooker and Baker's *Synopsis Filicum*,  
and other works, with New Species added.

By C. W. HOPE.

(Continued from Vol. XII, page 633.)

### PART III.—THE GENERAL LIST.

#### Ord. FILICES.

Sub-Ord. I. GLEICHENIACEÆ, *Br.*

Genus 1. **GLEICHENIA**, *Sm.*

Sub-genus MERTENSIA.

1. **G. dichotoma**, Willd.; Syn. Fil. 15. *G. linearis*, C. B. Clarke in C. R. 428. *G. linearis*, Burm., under Polypodium, Bedd. H. B. 4.

N.-W. P.: Kumaun—35-6000', S. and W.; Davidson; Askot, common 4-5000' Duthie; 6000' Trotter; 7500' MacLeod.

DISTRIB.—*Asia*: N. Ind. (Him.)—Nepal, Sikkim, and Bhotan 4-7000'. Assam—Dehing R.; Khasi Hills 5000', "common." *C. B. Clarke*; Sylhet. Centr. Prov.—Pachmarhi, *Duthie*. Centr. Ind., S. Ind. and Ceylon: mountains up to 6000'. Burma: Tenasserim, S. Andamans. Malay Penins. and Sumatra. E. Timor, *H. O. Forbes*, "an erect fern."

Scandent over other jungle, sometimes for several hundred feet, often rooting (*Clarke*). Probably the fern said to form, in Kumaun, jungle difficult to penetrate; but see above as to the habit of the plant in Timor.

Sub-Ord. II. HYMENOPHYLLACEÆ.

Genus 2. **HYMENOPHYLLUM**, *L.*

1. **H. exsertum**, Wall.; Syn. Fil. 58; C. R. 436; Bedd. H. B. 30.

N.-W. P.: *T. Garh.*—7-8000', P. W. Mackinnon; *Brit. Garh.* 9000' Duthie; Kumaun 6-8000'; S. and W., Hope, Duthie, J. R. Reid, Trotter.

DISTRIB.—*Asia*: N. Ind. (Him.)—Nepal, Sikkim, and Bhotan. 4-9000', very common eastward. Assam—Khasi Hills 2-5500', common; Manipur, *Clarke*, *Watt*. Centr. Provs., very common (Bedd.). S. Ind.: W. Ghâts, Madras Presidency. Burma: Tenasserim. Ceylon. China: Yunnan.

2. **H. polyanthos**, Sw.; Syn. Fil. 60; C. R. 437; Bedd. H. B. 31.

N.-W. P.: Kumaun—Dwāli and Nāmik 8-9000', S. and W.; Pindar Gorge 7-9000' Trotter.

DISTRIB.—"Widely diffused throughout the Tropics, and a little beyond them, both north and south." *Amer.*: from Cuba and Jamaica southward to Brazil, S. Chili, and Juan Fernandez. *Asia*: N. Ind. (Him.)—Sikkim and Bhotan 1000-12,000', abundant eastward. Assam—2-6000', "very common," *Clarke*; Kohima 9000', *Clarke*. S. Ind.:

W. Ghats of Madras Presidency. Burma. Ceylon. Malay Penins. Java. N.-Zealand. Afr.: W. Trop.; Masc. Isles.

### Genus 3. TRICHOMANES, Smith.

1. *T. Filicula*, Bory; Syn. Fil. 81. *T. bipunctatum*, Poir., C. R. 440; Bedd. H. B. 41.

PUNJAB: *Simla Reg.*—55-6000', Edgew., Hope, Gamble, Blanford, Trotter.

N.-W. P.: *D. D. Dist.*—Mussooree 55-6000', frequent, Duthie, Mackinnons, Hope Kumaun.

DISTRIB.—*Asia*: N. Ind. (Him.)—Nepál, Sikkim, Bhotán 5000' and upwards common eastward. Assam—Khasi Hills 2-5000' and upwards, common; Manipu *Watt*. S. Ind.—All the W. forests of Madras and Bombay Presidencies up to 8000 Burma. Nicobar Isles. Ceylon. Malay Penins. Tonkin. Java. Borneo. Formosa. Japan. China. Polynesia. Afr.: Fernando Po, Natal, Cape Colony, and Masc. Isles.

This fern, in N.-W. India at least, is often slightly white-powdered, when dried, and generally highly aromatic, the scent being like that of some umbelliferous plant. My specimens, collected at Simla in 1871, are still fragrant. It grows in sheets or sods on rocks and tree trunks, just as *Hymenophyllum Tunbridgense* does in Europe, the creeping rhizomes and the roots being matted together. Specimens collected by Mr. G. Mann in the Khasi Hills of Assam, at 5000', are large and stiff, up to 5 inches long.

2. *T. pyxidiferum*, L.; Syn. Fil. 81; C. R. 140; Bedd. H. B. 42.

N.-W. P.: *T. Garh.*—Bok. Mt. 9-10000', Duthie; Kumaun—Pindar 8000', Strachey 1856, in Herb. Hort. Calcutta.

DISTRIB.—*Amer.*: From Mexico and W. Ind. southward to Brazil and Peru. *Asia*: N. Ind. (Him.)—Sikkim. Assam—Khasi Hills and Cachar. E. Bengal—Chittagong 0-1500', common. S. Ind. Forests (*Bedd.*). Burma. Nicobar Isles. Malay Penins, (6 in. l.) Borneo. New Caledonia. Afr.: Angola, Cape Colony, and Masc. Isles.

Mr. Clarke says there is no Himalayan example of this at Kew, except a scrap from Levinge, said to be from Dárjiling. I possess a specimen collected and given to me by Levinge in 1871. There is a specimen, from the Victoria Falls, Dárjiling, 6500', collected by Levinge, and presented by me, I think, in the Saharanpur Herbarium; and in Mr. Gamble's herbarium I find a sheet from the Tista Valley, Dárjiling district, 1000', No. 5052, collected by him in Sept. 1873; another sheet, collected by him Dárjiling 7500., No. 7216, Oct. 1879; and a third, No. 8054, Dárjiling, May 1880. There is, therefore, no doubt that this species is found in the Himalaya, and that it extends to the westward of the Ganges, for the plant got by Mr. Duthie in Tehri Garhwál has the distinctive broadly winged or bell-mouthed tube enclosing the fruit. Some specimens from Eastern India are much larger and stiffer than those just mentioned.

## Sub-Ord. III. POLYPODIACEÆ.

Genus 4. **ONOCLEA**, L, Sw., Mett., Hook.Sub-genus—**STRUTHIOPTERIS**, W.

1. **O. orientalis**, Hook. ; Syn. Fil. 46 ; C. R. 434. *Struthiopteris orientalis*, Bedd. H. B. 20.

N.-W. P. : *D. D. Dist.*—Jaunsar—Lokandi Hill, 8-8500', Duthie 30-4-1894, Gamble 6-1894.

DISTRIB.—*Asia* : N. Ind. (Him.)—Sikkim, Lachen 12,000' *Hook fil.* ; 9000' *Elwes* ; *Levinge*, 12,000'. Assam—*Simons* ; Khasia—*Jerdon*, *Mann*. W. China. Japan—*Hakodadi*.

This is new to N.-W. India : the station was discovered first by Mr. Duthie, who informed me at the time. I have a specimen from Mr. Gamble, collected by him in the same locality, later.

Genus 5. **WOODSIA**, Br.Sub-genus—**EUWOODSIA**.

1. **W. hyperborea**, R. Br. ; Syn. Fil. 46 ; O. R. 434 ; Bedd. H. B. 20.

AFGHAN. : *Kuram Valley*—Shendtoi Hills 10,500', Aitch., No. 983, 9-7-1879

KASHMIR : *Sind Valley*—75-8000', *Levinge*, once collected ; *Masjid Valley* : 12-13,000' ; *Tajwaḥ Nala*, near Sonamarg 9-10,000' ; *Liddar Valley*, Sonsal Nāla 13-14,000' ; *Liddar Valley*, above Kainmal, 12,000', Duthie 1893.

PUNJAB : *Kullu*—near summit of Rotang Pass, Edgew. 171, in *Herb. Hort. Kew* named *W. Ilvensis*, R. Br., on same sheet with Scotch and Norwegian specimens.

N.-W. P. : *British Garh.*—near Kuāri Pass, 11-12,000', Duthie 1885 ; *Kumaun*—Kutti Valley 12-13,000', Kutti Yangti Valley 14,000', Duthie 1886.

NEPAL W. : Nampa Gādh, 12-14,000', Duthie 1886.

DISTRIB.—*N. Amer* : Canada, in high northern latitudes, to the Saskatchewan River : not in the U. S. A. *Europe* : Norway, Sweden, Russia, frequent ; Brit. Isles—N. Wales, Scotland, rare ; French and Swiss Alps ; Tyrol ; Spain—Pyrenees ; Corsica and Sardinia ; Carinthia ; Silesia. Scarce in Central and South Europe ; though locally abundant in a few spots. *Asia* : Ural Mts.; the Amur and Manchuria, Mongolia and China.

Duthie's specimens from Kashmir, No. 13148 especially, and Nos. 13226 and 14127, are very woolly ; but they do not warrant the rehabilitation of Hooker's *W. lanosa*, because the specimens on which Hooker founded that species are all undoubtedly *Gymnogramme Andersoni*, Bedd. Duthie's specimens have all distinctly the indusium of *Woodsia*, and neither the shape nor the colour is that of *G. Andersoni*, to which Baker in his Summary of New Ferns, 1891, refers *W. lanosa*. Duthie's British Garhwal, and one of his Nepal specimens are more glabrous than the normal. I have also a glabrous plant, got by Duthie in Kumaun, with fronds larger than usual, and elongated pinnatifid pinnae, which may be a new species.



## Sub-genus—PHYSEMATIUM.

2. *W. elongata*, Hook. ; Syn. Fil. 47 ; C. R. 435 ; Bedd. H. B. 22.

PUNJAB : *Chamba State*—Ravi Valley 11,000', McDonell ; *Simla Reg.* 8-10,000' ; Gamble, Collett, Hope, Bliss ; *Kullu*, Trotter.

N.-W. P. : *T. Garh.* 9-10,000', Lev., Duthie, Herschel, Mackinnons ; *Brit. Garh.* 7-12,000' Mrs. Fisher ; Duthie ; *Kumaun* 7-10,500' S. and W., Davidson, Duthie, Trotter, MacLeod.

DISTRIB.—*Asia* : N. Ind. (Him.), Sikkim, 7-12,000', frequent.

This fern grows to a much larger size than is stated in the books. The Syn. Fil. gives a span to 1 ft. as the length ; Clarke—9 in. l. : 1—1½ in. br. ; and Beddome—1 ft.  $\times$  1-1½ in. I have a frond collected by the Mackinnons in T. Garhwál which, were it complete at the apex, would be about 18 in. l. by 2½ in. br., without the stipe ; and I find a note of having seen in their collection a frond nearly two feet in length.

## Genus 6. SPHÆROPTERIS, Wall.

1. *S. barbata*, Wall. ; Syn. Fil. 49. *Peranema cyatheoides*, Don, C. R. 435 ; Bedd. H. B. 22.

N.-W. P. : *Brit. Garh.*—7-9000', P. W. Mackinnon, April, 1881, Mrs. Fisher.

DISTRIB.—*Asia* : N. Ind. (Him.), Nepál, Sikkim, Bhotán, 6-10,000', plentiful eastward. Assam—Khasi Hills, 45-6000, plentiful. Manipur. S. Ind—Annamallay Hills, 6000'.

This plant is new to the westward of Nepal, and, so far as I know, has not been collected in the N.-W. Himalaya by any one but Mr. Mackinnon and Mrs. Fisher. A specimen of Wallich's in Kew from Nepál is named *Aspidium spectabile*.

## Genus 7. DICKSONIA, L'Hérit.

## Sub-genus—PATANIA, Presl.

1. *D. scabra*, Wall. ; Syn. Fil. 54 ; C. R. 436. *Dennstædtia scabra*, Bedd. H. B. 24.

PUNJAB : *Simla Reg.*—5-6500', Edgew., Gamble, Blanf., Trotter, Bliss.

N.-W. P. : *D. D. Dist.*—4500' (and upwards ?), Herschel, P. W. Mackinnon, and Hope ; *T. Garh.* 45-5000', Hope ; *Kumaun*, "No. 14, 16-6-49," in Herb. Hort. Saharapur ; near Naini Tal, Hope, 1861 ; 6500', MacLeod, 1893.

DISTRIB.—*Asia* : N. Ind. (Him.)—Sikkim, Bhotan (4-8000'), common eastward. Assam—Khasi Hills 4-6000', common. Burma and Malay Penins. generally, very common, Bedd.

New to the westward of Kumaun, I think.

2. *D. appendiculata*, Wall. ; Syn. Fil. 54 ; C. R. 436. *Dennstædtia appendiculata*, Bedd. H. B. 26.

N.-W. P. : *Brit. Garh.*—Upper Ganges Valley 5000', P. W. Mackinnon, April, 1881 ; *Kumaun* 5-10,000', Edgew., S. and W., Duthie, Trotter, MacLeod,

DISTRIB.—*Asia* : N. Ind. (Him.)—Nepál, Sikkim,

New to the westward of Kumaun. British Garhwál specimens were given to me by Mr. Mackinnon soon after collection.

Genus 8. **DAVALLIA**, *Smith*.

Sub-genus—**LEUCOSTEGIA**, *Presl*.

1. **D. membranulosa**, Wall. ; Syn. Fil. 91 ; C. R. 442. *Leucostegia membranulosa*, Bedd. H. B. 50.

N.-W. P. : Kumaun—Mohargiri Pass 6500', S. and W., 1848 ; Davidson 1875 ; Duthie 1884-86 ; 4700', Hope 1890, "6-10,000'," MacLeod 1893.

DISTRIB.—*Asia* : N. Ind. (Him.)—Nepal, Sikkim, Bhotán (4-10,000'). "*Assam*" in Herb. Hort. Sahar (ex Herb. Hort. Calc.) *D. Assamica* on ticket.

I cannot see the nearness to *D. multidentata* which Mr. Clarke sees. *D. membr.* is bi-pinnatifid to a winged rhachis : *D. multident.* is tri-pinnatifid to a winged rhachis in all the specimens I have seen but one ; in other words, a frond of *D. membran.* a pinna of *D. multident.* The exception is a frond collected by Levinge, Darjiling, 7000', 1879, given by me to the Herbarium of the Imperial Forest School, Dehra, which is truly lanceolate, and measures only about 8,  $\times$  3½". st. 3½". *D. multidentata* is, I think, a more coriaceous plant than is *D. membranulosa*, and dries of a darker colour. A striking feature of *D. membranulosa* is the small glistening involucre, which seems very persistent. This is not mentioned by any of the authorities I cite. In this respect *D. membranulosa* is like *D. assamica*, Baker.

2. **D. immersa**, Wall. ; Syn. Fil. 91 ; C. R. 443. *Leucostegia immersa*, Bedd. H. B. 51.

PUNJAB : *Chamba*.—Dalhousie, McDonell ; *Simla Reg.*—Simla, Collett, Bliss, rare.

N.-W. P. : *D. D. Dist.*—Mussooree 6-7000', Herschel, Mackinnons, Hope, A. Campbell ; Dehra Dun 2600, Hope ; Kumaun, S. and W., Davidson 5-8000', Duthie 47-5000', Hope 47-5000', Trotter 75-8030'.

DISTRIB.—*Asia* : N. Ind. (Him.)—Nepál, Sikkim, Bhotán 3-6000', plentiful Assam—Khasi Hills 4-5000', common. Bengal—Parasnath Mt. (summit), Hooker, Dr. J. J. Wood, 1880. N. Manipur, C. B. Clarke 5500', Watt 6000'. S. India—Madras Presidency, W. Mts. "very abundant in Coorg, growing on trees" (Bedd.) Malay Penins., Java.

The authors of the *Synopsis Filicum* say this *Davallia* is peculiar in having the rhizome developed beneath the surface of the soil, but Beddome says that in Coorg it grows on trees. Clarke says—"rhizome much underground, and there without scales ; the tips above ground with chestnut lanceolate-acute scales." At Mussooree the fern grows on rocky ground or on rocks, and I have seen it in Kumaun on rocks. Down in the Dehra Valley (Dun) it grows on precipitous sandstone rocks, and I noted—"rhizome creeping on rocks, but burying itself in crevices where possible."

3. *D. Clarkei*, Baker, in Hook. Ic. t. 1625; Syn. Fil. 91. *D. dareeformis*, Levinge MS.; C. R. 443. *Leucostegia Hookeri*, Moore, under *Acrophorus*, Bedd. H. B. 52.

PUNJAB: *Chamba* 10,300', J. Marten 1898, *Simla Reg.*—Hattu and Bághi Road, Bliss, 22nd Sept. 1890; "Sirmur 9-11,000', T. T.", in Herb. Hort. Kew. (Another ticket for same specimen bears—"Hattu 8/49.")

N.-W. P. *D. D. Dist.*—Jaunsar, Cháchpur, Peak, 10,500', Gamble 1898.

DISTRIB.—*Asia*: N. Ind. (Him.), *Simla Reg.* 9000', very rare; Sikkim, Bhotán, 5-12,000', Hook. fil. et Thoms., *Clarke, Levinge, Gamble*, rare.

I detected this among Mr. Bliss's ferns sent to me for inspection by Mr. Trotter, and pronounced it to be *D. Clarkei*, Baker, from reading Beddome's description of *Leucos. Hookeri*, Moore, but I had not my Sikkim specimens (from Levinge) at hand to compare it with. I sent Mr. Bliss's plant home to Mr. Levinge, who, in returning it, wrote—"The *Davallia* you sent me is certainly *D. Clarkei*, identical in all respects, rhizome, scales, indusium, &c., with my Sikkim specimens. It is quite different from *D.* (or *Polypodium*) *dareeformis*. *D. Clarkei* is very rare in Sikkim, only once or twice found I believe." Clarke in the 'Review' says that *D. dareeformis* is frequent, both in the Himalaya and Khasi hills; but in a subsequent paper (Journ. Linn. Soc. Bōt. Vol. XIX, 291) he says that Levinge united ferns of two different genera in one species. *Polypodium dareeforme*, Hook., is I believe quite common in the Khasi Region, and I have never seen an involucre on it. I gather that Levinge inclined to agree with Beddome that *P. dareeforme* might be a *Leucostegia* nearly allied to *D. Clarkei*. The indusium of *D. Clarkei* is very broad, and quite persistent. In Gamble's plants, some collected by himself in Sikkim, and afterwards kept in cultivation at Darjiling, I see large, broad beautifully orange-red scales scattered over stipe and rhachises. The locality, variously called "Sirmur, 9-11,000'" and "Hattu," where Thomson got the specimen in the Kew Herbarium, is doubtful; but, as the hills of the Sirmur Territory, south of Simla, are not so high as 9-11,000', I think Hattu Mt., eastward of Simla, the summit of which is 10,500', must be the real habitat, and Mr Bliss's discovery of the plant at a lower level on that mountain 41 years later, confirms this view. Anyhow, eleven degrees of longitude separate the Punjab and the Sikkim habitats. Large specimens of *D. Clarkei* from N.-E. India are very like *Asplenium ternifolium*, Don, in shape and cutting. After the above was sent to press Mr. Duthie sent me large and beautiful specimens collected in Chamba by Mr. J. Marten, in a quite young state and about the same time Mr. Gamble gathered rhizomes of the plant in Jaunsar from which the young fronds of 1898 had not yet sprung up.



[I have struck out of this list *Davallia pulchra*, Don, as I find that the common low-level, arboreal fern I and other collectors have been calling by that name is *D. pseudocystopteris*, viz.—No. 4, *infra*. I do not think *D. pulchra* grows to the westward of Nepal, though it seems to be very common in the N.-E. Himalaya and Assam (in the Khasi Hills at least), and on the Western Mts. in S. India, and also in Tenasserim and Ceylon.]

4. *D. pseudo-cystopteris*, Kunze Bot. Zeit. 1850, 68. "Fronde humile, submembranacea, rigidula, olivacea, glabra, breviter oblonga, acuminata, tripinnatifida (s. quadripinnata); pinnis petiolatis, patentibus, oblique ovato-oblongis, obtusiusculis, inferioribus remotis; pinnulis primariis petiolatis. subrhombicis, obtusis; secundariis subsessilibus, oblique oblongis, pinnatisectis. sementis e basi cuneato falcato-lanceolatis, longe acuminatis, acutissimis, subbifidis, basi mono-sorophoris; indusio magno, ovato, acuto, membranaceo; stipite brevi, tenero; rhachi universali subflexuosa. versus apicem marginata, partialibus alatis, flexuosis; rhizomate . . . . . *Cystopteris Davallioides*, Kze in litt. 1842."

"Himalaya, aus den Sendungen Fieldings, von Moricand mitgetheilt."

*D. pulchra*, Don, var. *pseudo-cystopteris* (sp.), Kze., C. R. 444. *Leurostegia pseudocystopteris*, Bedd. H. B. 54.

PUNJAB: *Chamba*—6000'; *Kangra Vy. Dist.* 7000'; *Manāi State* 5500'; *Simla Reg.* 5-8000', "very abundant on trees" (Blanford).

N.-W. P.: *D. D. Dist.*—Mussooree and vicinity 5-7000', everywhere clothing the branches of the oak trees; *T. Garh.* 5000'; *Kumaun* 4500—11,000'.

DISTRIB.—*Asia*: N. Ind. (Him.)—Nepal, Sikkim and Bhotān up to 11,000'. Assam—Khasi Dist. 3-6000', common.

The plant from the localities enumerated above is the common low-level arboreal *Davallia*. Specimens differ from each other in texture and cutting, correspondingly, perhaps, to the age and degree of fertility of the plant; but I do not think any of them are *D. chaerophylla*, Wall., which has been assumed to be *D. pulchra*, Don (an older name), and which is common from Nepal eastward to Assam and Burma, and in South India and Central Ceylon. I have had great difficulty in determining what this plant is, but probably it is Kunze's plant, which, there are reasons to believe, was collected in the Simla Region. His description, which I have quoted above, is defective in that he could say nothing about the rhizome; and I cannot see that the indusium (in my material) is large, as he said it was, but it appears on young and undamaged specimens "ovate, acute, membranaceous." As I found that no type specimens of Kunze's plant existed in the Kew or British Museum Herbaria, I



asked Mr. Gustav Mann to inquire for them in Germany, and his reply, received on the 4th January, 1898, gave me the clue I wanted. Mr. Mann found that there is a type sheet, of two specimens, in the Botanic Museum, Leipzig, and he sent me a pen and ink sketch tracing of the larger of the specimens, and copies of Kunze's two tickets belonging to it. The older ticket bears—"*Cystopteris davallioides*, Kunze, in litt. ad Moricand, 4/43; species insignis *Leucosteleis affinis*, Presl. Himalaya Fielding, Ex herb. Moricand, 4/42." The newer ticket bears—"nunc—*Davallia* (Leuc.) *pseudocystopteris*, Kze.=*chaerophyllum*, Hook. Sori et indusia in *apice* nec in decursu venæ; ita que *Davallia*." Mr. Mann has written on the tracing—"Rhizome there is none, and the lower part of the stipe is also wanting. The frond is lanceolate as shown in this tracing. The sori are not ripe in this specimen, and no sporangia developed, the indusia are distinctly pointed ( $\Delta$ ): the ultimate segments very acute and, as well as the other cutting, just like that on a specimen collected by Blanford, 16-8-1885, on Summer Hill, Simla, 7000'." The tracing shows a lanceolate frond 8" l. by  $2\frac{3}{4}$ " br., the lowest pair of pinnæ slightly shorter than the two next pairs, but broader. On getting Mr. Mann's letter I recollected that some of my N.-W. Himalayan specimens which I had been calling *D. pulchra* had indusia "ovate, acute," though very small, and I found I had been overlooking Kunze's description of the indusium. I turned up my specimens, and verified my recollection. In immature specimens the ovate, acute, membranaceous indusium is quite distinct, but when the sori develop and ripen the indusium is pushed back and shrivels, and the true shape is not seen; and, also, specimens get damaged in the press. Mr. Mann, in his letter to me, says that the ultimate segments of Kunze's type specimen are perhaps a little longer than those of a Mussooree specimen he has from me, but that otherwise the cutting is exactly the same. He also writes—"The remark '=*chaerophyllum*, Hook.,' on Kunze's label was written by Kunze, but, as seems to me, at a later date. There is a second sheet of *D. pseudocystopteris* in the Botanic Museum, Leipzig, which has written on the label '*Davallia chaerophylla*, Wall. Herbar. Sprengelianum, 17260, ab ipso!' but not written by Kunze. This specimen is put together with the above type sheet in the same wrapper; it is the common Indian form of *pseudocystopteris*, with deltoid frond." The usual shape of frond of the plant I identify as *D. pseudocystopteris* is certainly deltoid, or at least sub-deltoid, but I have a lanceolate frond on the same rhizome with deltoid fronds. The rhizome is of course creeping and branching, and it appears to have broadly ovate scales, peltately attached, not adpressed, smaller than the similar scales of the next species, *D. Beddomei*; they are, however, rarely present in my material. Underneath the scales the

rhizome appears to be covered with a detachable skin or bark, somewhat wrinkled or striated. It is desirable that specimens of this plant should be collected at various stages of growth, to show the rhizome scales and the indusium distinctly.

It will be observed that Kunze at first called this plant *Cystopteris davalloides*, but finding it was a *Leucostegia* in everything but the shape of indusium, finally named it *D. (Leuc.) pseudocystopteris*, the name being evidently suggested by the shape of the indusium, which, however, does not seem to have its base inserted under the sorus as in *Cystopteris*. Further examination may show that this plant, from the shape of the indusium, deserves to be put in a separate genus, or sub-genus, as much as other *Davallias* do.

5. *D. Beddomei*, n. sp. Plate I. (see Part II., p. 527).

PUNJAB : *Chamba*—J. Marten, 1898.

Sub-genus MICROLEPIA, Presl.

[Kumaun is given by Clarke, in his 'Review,' as a habitat for *D. (Micro.) marginalis*, Wall., and also for *D. calvescens*, Wall., which he places as a variety of that species ; but as there is a mistake in the citation of Wallich's catalogue number by Hooker in the *Species Filicum* which he follows, he thinks the locality "Kumaun" may be a mistake. Beddome has copied Clarke without any such reservation. Hooker did not give Kumaun as a habitat for *D. villosa*, Wall., which is placed as a synonym of *D. marginalis* in the *Synopsis*, but only Nepal ; he gave Kumaun as a habitat for *D. calvescens*, Wall., which he considered a distinct species. On his type sheet of *D. villosa*, Wall., Cat. 244, in the Calcutta Herbarium, Wallich wrote—"Legi in Nepalia, 1821." The entry in the original catalogue in Calcutta is of this specimen only ; and Dr. Prain has shown me that there was no subsequent entry. I have seen no specimen of either of these ferns, collected in modern times in Kumaun, or the westward of it. Mr. Clarke seems to have been misled by two sheets in the Kew Herbarium without tickets, but marked on the sheets by Sir W. J. Hooker—" *Davallia calvescens*, Wall., Cat. 2683, Kumaun, Wall." This is not warranted by the entry in the catalogue. The distribution of the species, or of both species, is Asia. Nepal, Wallich ; Assam—Khasi Hills, Griffith, Mann ; Mikir Hills, Simons, N. Manipur, Clarke. Tonkin, Balansa. Formosa, Wilford.]

Sub-genus MICROLEPIA, Presl.

6. *D. Wilfordii*, Baker ; Syn. Fil. 98. *D. rhomboidea*, Hook. 2nd Cent., t. 48, not Wall.

"Caudice gracili elongato repente atro nitidissimo fragili, stipitibus sparsis 3-4 uncias longis stramineis nitidis basi ebeneis, frondibus C-8 uncias longis

oblongo lanceolatis acuminatis tenui-membranaceis pallide viridibus pinnatis, pinnis patentibus inferioribus remotis subnuciam longis rhombico-subtriangularibus longo petiolatis profunde pinnatifidis subpinnatisve oblique obovatis inequaliter lobatis, sterilibus serrulatis, venis subflabellatim dichotomis apice soriferis, invol. ris orbiculari-cuneatis membranaceis apice erosa solummodo libera lobulis fundium marginis conformibus, rachibus gracilibus subflexuosis, pinnis supremis sublanceolatis."

Mr. Baker's description is :—

"53 *D. (Micro.) Wilfordii*, Baker ; rhizome creeping ; st. 4-6 in. l., slender, naked, flexuose ; frond 6-9 in. l., 2-3 in. br., lanceolate, tripinnatifid ; lower pinnae deltoid, stalked, about 1 in. l.,  $\frac{1}{2}$  in. br., cut down to the rachis below with broadly ovate-rhomboidal sharply toothed *pinnules* ; texture herbaceous ; rachis and both surfaces naked ; sori 2-6 to a pinnule, apical in the teeth.—*D. rhomboidea*, Hook. 2nd Cent., t. 48, not Wallich. *Microlepia Wilfordii*, Moore.

HAB.—Japan ; gathered by both Messrs. Wilford and Oldham."

KASHMIR : "Boniar Nala—5,000' ; wet place," J. C. McDonell, June, 1897.

DISTRIB.—Asia : China—M. Tsen Mts., *Faber* 1885 ; Manchuria, between Mukden and Tung-che-Shien, *H. E. M. James*, 1886 ; Peking Mts., *W. Hancock* 1880 : "In shady glens by streams, along with *Cystopteris fragilis*"; *Dr. Bretschneider*, "Flora Pekinensis, 1880 (?). Korea—Am-nok River, Pbyingan Province, 1884. Japan—Hakodadi, *C. Wilford*, No. 1037, 1859 ; Yokohama, *R. Oldham*, 7/61, No. 99, "on rich moist banks on the hillsides"; *Maximovicz*, *Iter Sec.*, 1862, *F. V. Dickens* 11. Yokohama and Bukenje, *Jas. Bissett*, 1887 (?), Yokohama, *Maries* (from Veitch, 1880), *Hancock*, 144, 1885 ; "Japau," *Faurie*, Nos. 312 and 4223 ; Japan—Mt. Akagi 1888, from Science College, Imperial University, Japan (Jap. Wō renshida).

This plant seems to be more common in Japan and N.-E. China than was known when Sir W. Hooker described it. I cannot find that Moore did more than name it. But there is no record from the westward of the Peking Mountains except Mr. McDonell's discovery of it in Kashmir in 1897. The species seems to be terrestrial, judging from Oldham's and Hancock's remarks above quoted, as well as from McDonell's specimens, one of which reached me with fine micaceous sand adhering to the thin creeping rhizome. The cutting and texture are like those of *D. (Leuco.) immersa*, Wall., but the frond is narrow, and the sori are much smaller and apical.

In reply to an inquiry as to habitat, and for further material, Mr. McDonell wrote, in November, 1899, that this is a terrestrial species: he found it growing in a shady glen, close to running water. There was very little of it, and he has not been to the place since.

7. *D. platyphylla*, Don. ; Syn. Fil. 99 ; C. R. 446. *Microlepia platyphylla*, Bedd. H. B. 66.

N.-W. P. : *T. Garh.*—Near Mussoorie 4,000', Mackinnons, 1879.



DISTRIB.—*Asia*: N. Ind. (Him.) Nepal to Bhotan 3-5,500', plentiful in Sikkim. Assam—Khasi Hills 3-4,000'. North Manipur, 5,500', *Clarke*, 3,000', *Watt*. Upper Burma, 4,800', *Genl. Gatacre*, 1889. S. India—Madras Presy., throughout W. Mts. up to nearly 6,000'. Ceylon. China—Yunnan, *Hancock*, 1893.

A specimen gathered in Tehri Garhwal by the Messrs. Mackinnon was given by them to me in 1880 or 1881. The plant is unmistakeable. That appears to be the only known gathering west of Nepal. *D. lonchitidea*, Wall. Cat. 240, is a synonym.

8. *D. hirta*, Kaulf.; Syn. Fil. 100. *D. polypodioides*, Don.; C. R. 447. *Microlepia speluncea*, var. *B. hirta* (?); Bedd. H. B. 68.

N.-W. P.: *Brit. Garh.*—5,000', P. W. Mackinnon, 1881; *Kumaun*—Ramganga R. 2,600', S. and W., 1848, Sarju-Ganga Valley 5,000', MacLeod 1893.

DISTRIB.—*Trop. Amer. Asia*: N. Ind. (Him.), Sikkim, Bhotan. Assam—Khasi Hills. Bengal—Chittagong, 3-5,000', abundant. Manipur, 1,000—4,750'. S. Ind.—Madras Presy.—W. Mts. Bombay Presy.—*Herb. Dalzel*; N. Canara, 2,400', W. A. Talbot. Ceylon. Malayan and Polynesian Isles. China. Japan.

I pass lightly over this subject, being of opinion that the group comprising *D. strigosa*, *D. hirta*, *D. speluncea*, *D. polypodioides*, *D. flaccida*, &c., requires further study in the field. But I think the specimens from the westward of Nepal, above cited, come under *D. hirta*, Kaulf.

Sub-genus—STENOLOMA, Fée.

9. *D. tenuifolia*, Sw.; Syn. Fil. 102. *D. chinensis*, Sw., C. R. 449. *Stenoloma chinensis*, Sw., Bedd. H. B. 70.

PUNJAB: *Simla Reg.*—Simla, 5,000', Blanford. Trotter 6,5-8,800', Bliss.

N.-W. P.: *T. Garh.*—4-5,000', Duthie; *Kumaun*—Bagesar, 3,000', S. and W., 1848; Hawalbagh and Dwarahath "1849"; in *Herb. Hort. Sahar.*; 6-7,000' Davidson, Trotter.

DISTRIB.—*Asia*: N. Ind. (Him.)—Sikkim, Bhotan 1-7,000', plentiful eastward. Assam—Khasi Hills 1-3,000', common. Cent. Prov., India—Pachmarhi, *Duthie*. S. Ind.—Madras Mts.; The Deccan 3-6,000'. Ceylon. Japan. Polynesia, common. *Afr.*—Mascareen Islands.

Genus 10.—CYSTOPTERIS, Bernh.

1. *C. fragilis*, Bernh.; Syn. Fil. 103; C. R. 450; Bedd. H. B. 70.

AFGHAN: Griffith. *Kurran Valley*—Peiwar Kotal 8,000', Collett; 13,000' Aitch. 1879, Harsukh 1894; Ishkashin in *Badakshan*, Dr. Giles 1886.

TRANS-IND. STATES: *Baraul*—Ziarat—many stations 4,5-11,000', Harriss; Mirgo Hills, Gatacre; *Chitral*, F. E. Younghusband 1894; *Hindu Kush* (or Pamirs), Dr. Alcock, with the Pamir Boundary Commission, 1895.

KASHMIR: *Gilgit*, *Baltistan*, *Deosai*, *Gulmarg* and *Kilán*, *Shayuk Valley*—Ladakh 7-14,000', many collectors.

PUNJAB: *Hazara*, *Chamba*, *Kullu*, *Lahaul*, *Kangra Valley*, *Simla Reg.* 7-12,000'

N.-W. P.: *T. and Brit. Garh.* *Kumaun* 10-16,000', common.

NEPAL, W.: 10-13,000', Duthie.



DISTRIB.—*N. Amer.*: Arctic and Temperate Regions; California and Mexico. *S. Amer.*—"Whole length of Andean Chain." *W. Ind.* *Europe*: Everywhere from Iceland and Novaya Zemlya and Spitzbergen in the Arctic Regions to Spain, Sicily, Cyprus, and the Caucasus. *Asia*: Lebanon, Persia, Kurdistan, Siberia, Manchuria, Kamschatka, Thibet, N. China; *N. Ind.* (Him.), Sikkim. Australasia. *N. Zeal.* *Sandwich Isles.* *Afr.*—Madeira Fernando Po, Abyssinia, S. Afr.

[*Cystopteris suedetica*, *A. Br. and Milde*: Syn. Fil. 103, has been found in the Chumbi Valley, Thibet, by Sir George King's collectors.]

2. *C. montana*, Link.; Syn. Fil. 104; Bedd. H. B., Supp. 15.

KASHMIR: "In woods above Gulmarg, about 9,000', not higher, August 1877," Aitch. in Herb. Hort. Kew; Bangas—Muzafarabad—Inayat, Duthie's Collr. 21-7-97 (Saharapur Herb.)

*N.-W. P.*: *Kumaun*—near Rálam Glacier 13,000', No. 3547; near Ráma—Dhauli Valley 12-13,000'; Byáns—Kutti Valley 13-14,000'; above Nabbi 12-13,000', No. 3647, Duthie 1884.

NEPAL, *W.*: Opposite Buddhi Village 10-12,000'; Nampa Gádh 11-12,000', No. 6247, Duthie 1886.

DISTRIB.—*N. Amer.*: East side of Rocky Mts.; Labrador; Canada *W. Europe*: Mts. of Scandinavia, Scotland (very rare), and Centr. Europe. *Asia*: Kamschatka.

This fern was sent to Kew, with other plants, by its discoverer in Kumaun, Mr. Duthie, but that Indian habitat is not given in Mr. Baker's paper, "A Summary of the New Ferns which have been discovered or described since 1874," published in the "Annals of Botany," Vol. V. No. XVII, although new habitats of other old species are mentioned. Beddome, though he did not include the species in his Handbook, has entered it in the Supplement to that work, published in 1892, and has quoted the description given in the *Synopsis Filicum*, but he has given as the only Indian locality "Kashmir," without mentioning the collector's name. Mr. Duthie sent me Kumaun and Nepal specimens soon after he collected them, and I know that he has never found the plant in Kashmir. Beddome has possibly entered Kashmir as the Indian habitat on the strength of Dr. Aitchison's specimen mentioned above.

I may be pardoned for mentioning that I have an old acquaintance with *C. montana*, for, when on an excursion in Perthshire, conducted by the late Professor J. H. Balfour, in 1856 I think, I discovered a station for the plant on Ben Lawers, on which mountain, in 1836, it had been found for the first time in Scotland by Mr. W. Wilson, but where it had not since been gathered for long. I have read with interest that lately new stations for this fern have been discovered on the border between Perthshire and Argyllshire, and even in Dumbartonshire. It is a 'far cry' from Central Europe eastward to Kashmir.

(To be continued.)



## THE FERNS OF NORTH-WESTERN INDIA.

Including AFGHANISTAN, the TRANS-INDUS PROTECTED STATES, and KASHMIR: arranged and named on the basis of Hooker and Baker's *Synopsis Filicum*, and other works, with New Species added.

By C. W. HOPE.

(Continued from Vol. XIII, page 36.)

### PART III.—THE GENERAL LIST.—(continued).

#### Ord. FILICES.

#### Sub-Ord. III.—POLYPODIACEÆ.—(continued).

##### Genus 11.—**ADIANTUM**, L.

1. **A. lunulatum**, Burm.; Syn. Fil. 114; C. R. 452; Bedd. II. B. 82.

PUNJAB: *Chamba*; McDonell (in list); *Kangra Valley* W. 2800', Trotter; *Mandi State* 4000', Trotter; *Simla Reg.* 2-4500', Hope, Blarf., Bliss.

N.-W. P.: *D. D. Dist.*; common from the valley up to 4500' in the Himalaya; *Kumaun* 1800'—5800'.

DISTRIB.—*Trop. Amer*: from Mexico southward to the Organ Mts. in Brazil. *Asia*: N. Ind. (Sub-Him. and Him.) up to 4500', very common. Bengal—Chutia Nagpur. Cent. Prov. Cent. Ind. S. Ind. Very general on the western side, in the plains and lower slopes of the hills (Beddome). Burma. Ceylon. Malay Penins.—Perak. Cochin China. China—Hongkong. Polynesia. *Trop. Australia*. *Afr.*: Cape Verde Isles, Angola, Guinea, Zambesi Land, Madagascar.

This is one of those ferns that are so common along the foot of the Himalaya that one neglects or postpones collecting them. It grows even by the roadside in the heart of the town of Dehra, and onwards to Rajpur on the way up to Mussoorie. Far to the southward I gathered it in 1860, in Bagelkhand, Centr. Ind., alt. about 800'. Mr. Gamble got it in Bengal—Lohdardaga Dist., Mr. Clarke in Centr. Ind., and Mr. Duthie in the Centr. Provs. Mr. Clarke says it is plentiful in ditches in Calcutta.

The cutting of the pinnæ of this species varies much. The largest fronds I have from Darjiling, collected by *Levinge*, have entire pinnæ, with only the marginal row of sori broken. Smaller fronds of the same gathering have pinnæ cut down  $\frac{1}{3}$  to  $\frac{1}{2}$ -way to the lower edges, with one, two, or three lengths of sorus to each of the 5 or 6 lobes. In the *Syn. Fil.*, the pinnæ are said to be subdimidiate; but I should say that the costa, or main vein, of a pinna forms the lower edge: the veins radiate from the attachment of the petiolate secondary rhachis, or from the costa near it, and may be said to be about 12 in number at the base of the pinna. They form dichotomous groups stretching to the lobes, and sub-lobes if any, and they continually fork or branch up to close to the edge of the pinna, until there must be from two to three

hundred veinlets at the row of sori, in a large pinna. This of course gives the required stiffness to the pinna, the lamina of which is membranous in texture.

2. *A. caudatum*, L. ; Syn. Fil. 115 ; C. R. 453 ; Bedd. H. B. 83.

KASHMIR : *Jhelam Vy.*; from Uri downward, MacLeod ; *Tawi Vy.* 5000', Trotter ; "3000', very common," Gammie.

PUNJAB : Hazara—35-4000, Trotter. *Chamba*, McDonell (in list) 3000', Trotter ; *Kangra Vy.*, W. 3000', E. 4500', Trotter ; *Salt Range*, Aitch. ; *Kullu* 5500', Trotter ; *Simla Reg.*, below Simla 35-4500', Hope, Gamble, Blauf.

N. W. P. : *D. D. Dist.*, common, up to nearly 5000' in the Himalaya ; *T. Garh.* 4-5000', Duthie ; *Kumaun* 6500' S. & W., Davidson, Hope 2000', common.

DISTRIB.—*Asia* : Arabia Felix. N. India (Himalaya and other Mts.) 0-3000' very common. Centr. Provs., Ind. Centr. Ind. Bengal—"In Mont. Behar, Calc. to Agra," Jacquem., Dhakka. Bombay Presy.—Poona Jacquem. Burma—Tenasserim. S. Ind. and Malay Penins., plains and lower slopes of hills (Bedd.), Ceylon, Java, Borneo, Philippines, China. *Afr.*, Cape Verde Isles., Banks of the Niger, Angola, Zambesi Land, Cape Colony, Mauritius.

This species, the last preceding, and the next following, belong to the "radicantes group," the rhachis being often prolonged and rooted at the point. A specimen gathered in the Dehra Dun has fronds about three feet long, perhaps one-half consisting of secondary growth. The fronds hung down from the bank of a stream, and had rooted and grown in the air, like *Saxifraga sarmentosa*.

3. *A. Edgeworthii*, Hook., Sp. Fil. II., 14 ; Syn. Fil. 2nd Ed. 472.

*A. caudatum*, L. var. *β. rhizophorum*, Wall., C. R., 453. *A. caudatum*, L. var. *β. Edgeworthii*, Bedd. H. B. 84. *A. Edgeworthii*, Hook., Bedd. Supp. H. B. 17.

PUNJAB : Adah Valley near *Multan*, M. P. Edgew., Sept., 1838 ; *Simla Reg.*—Bhajji State 5-6000' Trotter ; Simla 5-6250', Hope, Blauf., Bliss.

N.-W. P. : *D. D. Dist.*—5-6000', Mackinnons, Hope, Duthie, rare ; *T. Garh.* 4500', Hope ; Suarna-ka-ser, 6000', Gamble, 1898, "*Garhwal*, Edgew., A. Hume" (Clarke) Mrs. Fisher ; *Kumaun*, 3-6000' S. and W., A. Hume, Hope, Davidson, Duthie, Trotter, MacLeod.

DISTRIB.—*Amer.* : W. Ind. Sieber, in Herb. Hort. Sahar. (7 pair of pinnae only), *Asia* : N. Ind. (Him.). Nepal, *Wallich.* Assam—Khasi Hills 4500', Mann. Manipur, *Clarke*, *Walt.* Burma—Fort Stedman, Abdul Hak, 1893. China—Peking, *Dr. Williams*, *Dr. Bushell*, *Hancock* (largest I have seen). Malay Isles. Timor, *H. O. Forbes*, 1882-83.

Since gathering it in Kumaun, in 1861, I have always considered this a distinct species. It has been long in obtaining general recognition. Published by Hooker in 1858, in the *Sp. Fil.*, it was reduced in the *Syn. Fil.* to the place of a synonym of *A. caudatum*, *β*, *A. rhizophorum*, Sw., and but doubtfully raised in the 2nd Ed. to the rank of species. Clarke in his "Review"



adhered to the view taken in the first edition of the *Synopsis Filicum*. In his Hand-book of 1883, Beddome placed *A. Edgeworthii* as *var. Edgeworthii* of *A. caudatum*, but in the Supplement of 1892 gave it full rank. The only habitat Hooker cited (knew of ?) was near Multan, where originally it was discovered by Mr. Edgeworth. Hooker says :—"Mr. Edgeworth, in his notes, observes of this, 'it is not *A. rhizophorum*' (for indeed the texture of the frond and venation are totally different), 'nor *A. caudatum*, Sw., nor *flagelliferum*, Roxb. n. 76' (for in those varieties of one and the same plant the fronds, and especially the stipes, are more or less clothed with fulvous hairs or chaff) : ' (it differs from all in the integrity of the pinnae).' On these grounds I give it as distinct, though we need more copious specimens to see that it does not pass into *caudatum*." Sir W. Hooker goes on to remark that "the nerves are the same" ; ... "the fertile pinnae scarcely exhibit an appearance of lobes ; and the contiguous sori form a pretty even line at the edge." From this it appears that the first parenthesis, in the quotation from the *Species Filicum* given above, is a version of Edgeworth's original note, and, from a careful examination of the numerous specimens of both species in my collection, I think I can say that as regards the venation Edgeworth was right, and Hooker wrong ; and the venation shown in the enlarged figures of the two species, Plates LXXX and LXXXI, Sp. Fil., seems to bear me out. In *A. caudatum* (*A. rhizophorum*, Sw.), so far as I can see, the system of venation is flabellate, *i.e.*, the veins all radiate directly from the petiole, whereas in *A. Edgeworthii* a branch of the petiole, corresponding to the costa of a dimidiate pinna, runs along the inferior, straight edge of the pinna, giving off branches inwards all along its length. It is not always clear whether this branch, or costa, itself forms the thickened, or stiffened, margin of the pinna, or whether the thickened margin is outside of it ; but this inferior vein, or costa, gives off no branches on the outer, or inferior, side. The inferior vein of a pinna of *A. caudatum* seems to me to branch towards the inferior margin, as well as upwards. But the venation of *A. caudatum*, shown in Beddome's enlarged figure, t. 44 of the Hand-book, is as I have described it for *A. Edgeworthii*.

I must, with regret, impeach the integrity of the pinnae of *A. Edgeworthii*, certified to by Edgeworth, and partly doubted by Hooker and Beddome, for the lobes are always more or less distinct and deeply separated, especially in barren fronds, though the divisions are never so deep as they often are in *A. caudatum* ; when they are shallow, they are sometimes obscured by the involucre overlapping them, and even each other. The involucres are often deeper (broader ?) than in *A. caudatum*, and they are membranous, transparent, and larger than the ripe sori are. When turned back, and the sporangia scraped

off, they show the prolongations of the veinlets in them very distinctly; but the veinlets appear to break connection between the lamina and involucre at, or at a stage prior to, the maturity of the sorus. The involucres of *A. caudatum* are coriaceous, and narrower I think.

The differences of venation and involucre, taken together with the now-known wide range of habitat—from Sind to China and Timor, and perhaps the West Indies—and the yet rarity of the plant, besides the differences of texture, quite justify the tardy elevation of *A. Edgeworthii* to a species.

*A. Edgeworthii* seems generally to have longer stipes than *A. caudatum* has, sometimes almost as long as the fronds are. *A. caudatum* has very short stipes, unless the fronds have had to struggle out from between rocks or loose stones.

4. **A. Capillus-Veneris**, L.; Syn. Fil. 123; C. R. 453; Bedd. H. B. 84.

AFGHAN.: *Kurram Valley*—Aitch, 1879, 3200', Aitch. 1884-85.

TRANS-IND. STATES: *Kafiristan* and *Badghis* 5000', Aitch. 1885; Kaghni (?) 5500', Giles, 1886; *Swat* and *Baraul* 6-8500' (5 stations), Harriss, 1895, 4-6000' (3 stations), Gatacre, 1895.

KASHMIR: 35-8000', Trotter, Duthie, MacLeod; "common in Kashmir in moist places" (MacLeod).

PUNJAB: *Hazara*—Gatacre, Oertel, Trotter. *Chamba*—McDonell (tripinnate); *Rawal Pindi*, Aitch.; *Kangra Valley Dist.* W.—25-3000', 3-4000' Trotter; *Kullu*—5-6000', Trotter, *Simla Reg.* 35-6000', Hope, Gamble; *Bisahir*—7000', Lace.

N.-W. P.: *D. D. Dist.*—Jaunsar 3000', Gamble, Mussoorie and below it 47-6000', Hope; in the Dun 1-3000'—very common by running or trickling water and within reach of spray: on banks of canal cuttings, in Dehra; *T. Garh.* 3-4000', Duthie; *Saharanpur Dist.*—Dolkhand, Gamble; *Kumaun*—Sarju Valley 3500', Jagthana 5200' S. and W.; below Naini Tal, in the Gola Valley, 5-6000', Hope, 1861: station long ago swept away in landslips; Gola Valley, 2500', Hope, 1890; Káli Valley 7-8000', Duthie; Rámghanga Valley 4-5000', Trotter.

DISTRIB.—*Amer.*: Florida, southward to Venezuela and Amazon Valley. *Europe*; United Kingdom (Ireland, Isle of Man and S. W. Eng.), Central and Southern Europe, Caucasus. *Asia*: Syria (Jerusalem, Sinai, Galilee), Siberia, Arabia, Beluchistan, common all over N. Ind.; Sind, *Dr. Stokes*; Bengal—in the Ganges Valley (Arrah, Dinapur, and Calcutta); Himalaya and valleys at foot of the range, common up to near 6000'; Assam—Khasi Hills. Centr. Provs., India. S. Ind.—Bombay and Madras Presidencies, common on west side up to 5000'. S. E. China. Japan. Polynesia. *Afr.*—Canary Islands and in many parts of the Continent, both North and South.

The distribution of this species in India is not fully indicated in the three books to which I restrict my references. I have specimens from walls in the Entally suburb of Calcutta, and I have taken it (a small size) from wells in Dinapore and Arrah; and Mr. Duthie got it at Pachmarhi in the Central

Provinces. It appears to be found all over India, where circumstances are favourable. Shade and permanent moisture are essentials ; and limestone is, I think, preferred.

5. *A. Wattii*, Baker, in Journ. L. Soc. XVIII, 1881, t. 14 a, figs. 1 and 2. *A. Levingei*, Baker, Ann. Bot., Vol. V. No. XVIII. *A. Capillus-Veneris*, L., var. *Wattii*, Bedd. Suppl. H. B. 18.

PUNJAB : Chamba—Pangi, G. Watt, Chenab Valley, Pangi 8000', McDonell, 1882 ; Kullu—75-10000', Trotter, 1887.

DISTRIB.—Asia : N. Ind. (Him.) ; Sikkim—Chingtam (or Chintang, or Chingtang) alt. 3,000', *Levinge* and his collectors ; S. Ind.—(Nilgiris), Leech Falls, Conoor R., *Lee*.

Baker's description under *A. Wattii* is the more detailed, but when analysed it does not seem to differ much from his later and shorter description of *A. Levingei*, of which plant I have seen and also possess very good specimens. I must have long ago seen McDonell's and Trotter's specimens from Chamba, but I can find no notes of them. *A. Wattii* is the older name, and, therefore, as I think there is only one species here, I put all the specimens, whether from the Punjab, Sikkim, or the Nilgiris, under this. The Nilgiri specimens I found in Gamble's collection, in the *A. Cap.-Ven.* bundle. Colonel Beddome, in his Suppt. of 1892, says that Mr. Baker described *A. Wattii* from some small poor specimens, and he gives both that name and *A. Levingei*, Baker, as synonyms of his *A. Cap.-Veneris*, var. *Wattii*, saying that copious specimens from both Sikkim and Chamba prove that Mr. Baker's (two) supposed species belong to the same plant. I add the Nilgiris as a habitat for one or other. Beddome gives a very detailed description of his var. *Wattii* of *A. Capillus-Veneris*, with which I find no fault ; but I may remark that it is remarkable that a "slight variety," as he calls it, of a common fern should require so minute and lengthy a description. According to this the variety seems to differ in every particular from the type. I see no grounds for reducing this fern to a variety of *A. Cap.-Veneris*. The superior pinnules on all the pinnae of *A. Levingei* seem the larger. Dr. G. King has recorded on a sheet of *A. Levingei*, from Sikkim, in the Calcutta Herbarium, that the scales of the rhizome are broader than the corresponding scales on *A. Cap.-Veneris*.

6. *A. æthiopicum*, L. ; Syn. Fil. 123 ; Bedd. H. B. 83.

AFGHAN. : Kurram Valley—Aitch., 1879, No. 1265 in Herb. Hort. Saharanpur.

DISTRIB.—Amer : from Texas and California southward to Valparaiso and Monte Video. Europe : Spain, G. McLeavy, 1860. Asia : S. Ind.—Nilgiri and Pulney Mts. at the higher elevations ; Ceylon. Australia—Temp. and Trop ; N. Zeal. Afr. : Cameroon Mts. at 7000', Abyssinia, Zambesi Land, Natal, Cape Colony, Bourbon, Madagascar.



This species seems very difficult to preserve : the pinnae drop off.

**7. *A. venustum*, Don. ; Syn. Fil. 125 ; C. R. 453 ; Bedd. H. B. 86.**

AFGHAN : *Kapristhan*, Griffith ; *Kabul*, Clarke (in Rev.) ; Kurram Valley, Aitch., May, 1879, No. 1264, Major (now Sir Henry) Collett, July, 1879.

TRANS-IND. STATES : *Baraul*, 5000', Harriss ; 8000', Gatacre.

KASHMIR : Clarke (in Rev.), 4-8500', Trotter ; 6000' Gammie, "common at all altitudes from 8000' to 10,000'," MacLeod.

PUNJAB : *Hazara Dist.*—Black Mt., Gatacre, 1838, Oertel, 1891 ; Kálapáni 6,500', Trotter, 1890 ; Kagan Vy. 4-8000', Inayat, 1896-7 *Chamba*—McDonell ; *Kullu* 10,000', Trotter ; *Mandi State* 5-6000', Trotter ; *Simla Reg.* 7-10,400', common.

N.-W. P. : *D. D. Dist.*—Jauusár 65-8000', Sundar Lal, C. G. Rogers, Gamble ; Mussoorie 5-7,000', not uncommon, Mackinnons, Hope ; *T. Garh.* 8-12,000', Duthie ; *Kumaun* 6-10,000', S. and W., Hope, Davidson, Duthie, Trotter, MacLeod.

DISTRIB.—*Asia* : N. Ind. (Him.) Nepal, Wallich

Trotter, in his privately printed List of the Ferns of the Punjab, has pointed out that Clarke, in saying that this is one of the commonest ferns of the N.-E. Himalaya, must have written North-East by mistake for North-West, and that Beddome has copied the mistake. I do not know of any specimen having been found in the N.-E. Himalaya. I have been told that a species of "Maiden Hair" is exported in cartloads from Jauusar, along the cart-road to Saharanpur, for some purpose, perhaps medicinal : this is probably *A. venustum*. Of the stipes and rhachises of a species of *Adiantum*, probably *A. monochlamys*, Eaton, the Japanese make brushes, or miniature brooms, for dusting china with. Blanford says this is "One of the commonest and most abundant ferns of Simla, covering banks and sloping ground in shady places, and ranging from 4500' up to the top of Hattu at 10,500'." *A. venustum* grows in the soil in forest : I have never seen it by running water like *A. Cap.*—*Veneris* ; but in 1861 I used to see it in the forest on the west side of the Naini Tal Lake, near the level of the water.

**8. *A. pedatum*, L. ; Syn. Fil. 125 ; C. R. 453 ; Bedd. H. B. 86, and Suppl. 19.**

KASHMIR : Ring Nála 8000', MacLeod, 1891 ; Kishenganga Valley—Kajfiban 7-8000', Duthie, 1892.

PUNJAB : *Hazara Dist.*—Siran and Kagan Vys. 12,000', Inayat, 1896 ; *Chamba*—"Upper Chenab Valley," Pángi 7000', R. Ellis, 1878, in Herb. Gamble ; 10,000' (perhaps in Kashmir) Baden-Powell, 1879 ; Ravi Valley—Tunda Valley 8000', McDonell, 1882 ; *Simla Reg.*—Hattu Mt. and vicinity 85-10,000', Gamble, Blauf., Hope Trotter, Bliss : in forest ; Raiengarh forest 8000' ; Gamble, 1898.

N.-W. P. : "*Garhwal*"—Sinjari, S. & W. ; *T. Garh.* 9-10,000', 6 stations, Duthie, Dr. Cantor ; *Brit. Garh.*—Mrs. Fisher ; Dombitia Gádh 9-10,000' Duthie ; *Kumaun*—Wallich ; "Dusali, near Pindree 8000'," Major Madden ; Pinsara 8000', Davidson ; Dhauri Valley 8-9000', Duthie.

NEPAL W. : Opposite Budhi Village 9-10,000', Duthie, 1886.



DISTRIB.—*Amer.* Unalashka and Canada, southward to Virginia and California. *Asia*: N. Ind. (Him.), Sikkim, scattered, not plentiful. China—Manchuria. Japan.

Both Clarke and Beddome give Garhwāl as the Western limit of this species in India, but it will be seen above that it was long ago obtained in Chamba, and perhaps in Kashmir, by Ellis and Baden-Powell; and more lately Macleod and Duthie have found it in the West of Kashmir. MacLeod says:—"Only on northern slopes of dividing ridge between Kishenganga and Jhelam valleys, 7-10,000'; not uncommon; grows to great perfection." It was on this ridge and in the adjacent valleys that MacLeod collected in 1891. Quite lately it has been found in the west of the Hazára District by Mr. Duthie's collector, Inayat. Seeing much of these ferns exhibited at shows in London, I once asked an exhibitor, Mr. Birkenhead, whence he got his supplies, and he said from N. America, never from India.

Genus 12—**CHEILANTHES** Sw.

Sub-genus—**ADIANTOPSIS**, Fée.

1. **C. Duthiei**, Baker, in Ann. Bot. Vol. V. No. XVIII; Bedd. Suppt. H. B. 20.

"*Stipes* densely tufted, castaneous, glabrous, 1—1½ in. long, with a few paleæ towards the base. *Fron*d oblong-deltoid, membranous, glabrous, 2 in. long, green on both surfaces. *Pinnæ* oblong-deltoid, sessile, lowest the longest, produced on the lower side. *Pinnules* oblong, ¼ — ½ in. broad. *Sori* placed all around the edge of the pinnules, usually orbicular, rarely confluent. *Indusium* grey, glabrous, orbicular-reniform, persistent. British Garhwal, Duthie, 5,144. Cutting of *C. subvillosa*, but indusium of this subgenus."

N.-W. P.: *Brit. Garh.*, near Kuári Pass, 12-13,000', Duthie 5144, 8-9-85; rocks east of Dhakwáni, 11-12,000', Duthie 5196, 11-9-85.

The name of this fern, and the above notes of habitat, were entered in the Catalogue of the Ferns in the Saharanpur Herbarium, published in 1890, in advance of publication by Mr. Baker,—I having seen it, and the entry in Mr. Baker's MS. list of new Ferns at Kew, in 1888. It is one of the rarest of Indian Ferns. The stipes reach 3½ inches in length.

Sub-genus—**EUCHEILANTHES**, Sw.

2. **C. fragrans**, Webb. and Berth. (non Sw.) ; Syn. Fil. 134. *C. fragrans* (Swartz, Syn. Fil.) Webb. and Berth., Phyt. Canar. iii. 452 ; C. R. 454. *C. fragrans*, Sw., Bedd. H. B. 88.

AFGHAN.: *Landikhana*—Griffith ; *Kabul*, (Clarke in Rev.).

TRANS-IND. STATES : *Chitral*—F. E. Younghusband, 1894 ; Baraul 4500' (6 stations) Harriss 4-5000', Gatacre.

PUNJAB : *Cherat* 4000', Collett 8-92 ; *Hazara*—Black Mt. 6000', Oertel, 1891 ; between Murree and Kohala 4000', Lev., 1876 ; Dhantaur Hill, and hill opposite to it 4,000' and upwards, Oertel, 1890-91, Trotter, 1890-92. "Punjab—Turki," Common



H. Hermusji del.

CHEILANTHES DUTHIEI, Baker.

Lith. by AC Mukerji.

1. Plant—natural size.

2. Pinna—magnified 4 diameters.



Aitch 6-78. *Chamba*—Ravi Valley 5-7000', McDonell, 1882; Chenab Valley 5000', T. T. 1848, J. Marten 1898.

KASHMIR: *Jhelum Valley*—near Pirni 5-6000', Duthie, 1892. *Kishtwar* 35-5000', C. R. Clarke, 1877.

DISTRIB.—*S. Amer.*? (*C. andina*, Hook.) *Europe*: Centr. France, Switzerland, Spain, Portugal, Italy, Greece, Turkey. *Asia*: Syria (Jerusalem, Lycia, Cilicia); Baluchistan. *Afr.*: Canaries, Madeira, Morocco, Algeria.

Clarke argues against Baker's dictum that this fern is not *C. fragrans* of Swartz; but all three authorities seem to agree that it is *Polypodium fragrans* of Linnaeus. Beddome does not mention Webb. and Berth. in the matter, and there seems no doubt that there is here only one species. The Himalayan plant is exactly the same as a specimen I have from the Canary Islands, Teneriffe near Oratava, collected by my friend Mr. P. Neill Fraser, except that the latter seems to have white powder on the involucres.

### 3. *C. subvillosa*, Hook.; Syn. Fil. 137; C. R. 456; Bedd. H. B. 93.

KASHMIR: Chittapani Valley, 9000', Rattan Pir 8000', Trotter.

PUNJAB: *Hazára Dist.*—Mian Jání Mt. 9000', the Gullies near Kalabágh 7000, Kalabágh 7500', Trotter; *Chamba*—Kálátóp Forest 7500', Rávi Valley near Alwás, 6800', McDonell; J. Marten, 1898; *Kullu*—Jalori Pass, N. 9-10,000', Trotter; *Simla Reg.*,—Great Thibet Road: Mahásu to Hattu Mt. 7-10,450', Edgew., Gamble, Blanf., Hope, Trotter, Bliss; Pábar Valley and Kotgarh, Edgew.

N.-W. P.: *T. Garh.*—Ganges Valley 9-10,000', and above Suki 9-10,000' (Duthie); Deota 6000', Dhamti 8000', Gamble; *Kumaun*—Káli and Dhauli Valleys 8-9000', Duthie.

DISTRIB.—*Asia*: Sikkim—Darjiling 7500', *Levinge*, 1880.

This fern is not so rare as was thought up to 1880 and 1883, when Clarke's and Beddome's books were published; but Beddome says nothing more about it in his Suppl. of 1892. There is now no break in its known range from the Indus to Kumaun, unless for the Kangra Valley and the Jaunsar Hill-tract of the Dehra Dun District.

### 4. *C. Dalhousiæ*, Hook.; Syn. Fil. 137. *C. farinosa*, Kaulf., var. *Dalhousiæ* (sp.), Hook. C. R. 457. *C. farinosa*, Kaulf., var. *β. Dalhousiæ*. Bedd. H. B. 93.

KASHMIR: 6-9000', frequent (Clarke in "Rev").

PUNJAB: *Hazára*—The Gullies—5 stations 75-9000', Trotter; *Chamba*—Dalhousie and Kajiár, Clarke; Kálátóp Forest, McDonell 7000—7500'; *Mandi State*—9-10,000', Trotter; *Kullu* 8-9000', Trotter; *Simla Reg.*—From Simla to Hattu Mt. 65-10,500', Hope, Gamble, Blanf., Trotter, Bliss.

N.-W. P.: *D. D. Dist.*—Mussoorie 7000', Hope, 1890; Jaunsar, Kanjátra 8500, Gamble, 1898; *T. Garh.*—Surkunda Mt. 8-9000', Lev. (*Levinge*), 1872; Jamnotri 10-11,000', Duthie, 1883; Dhamti, 8000', Gamble; *Brit. Garh.*—Dombitía Gádh 9000', Duthie, 1885; *Kumaun*—Naini Tál, Hope, 1861; 8-10,000', 4 stations, Duthie; Pindar Gorge 9-10,000', Trotter; Sarju Ganga Valley 6,000', MacLeod.



NEPAL—W. : Opposite Buddhi Village 9-10,000', Duthie, 1886.

DISTRIB.—*S. Amer.* : "Gathered also lately by Mr. White in New Grenada, and doubtless only a denudate variety of *farinosa*." (*Syn Fil.*) *Asia* : N. Ind. (*Him.*) Sikkim—Lachen Valley 10,000', Sinchal, 8000'.

I feel sure that the habitat given in the *Synopsis*—"North of Hindustan,"—so far as it may mean that the fern is got below the Himalaya, is a mistake : this is eminently a high-level fern. The remark in the *Synopsis* quoted above is, I presume, Mr. Baker's. I consider that Hooker was quite right in setting up this fern as a species. Whether in shape of frond, appearance, or habitat it is quite unlike *C. farinosa*, and there is no passage between them either physical or topographical. The specimens of *C. Dalhousiae* got by me in Mussoorie in 1890 were growing among *C. albo-marginata*, dealbate fronds of which are rather like it. I have not heard of *C. Dalhousiae* having ever been found elsewhere, or by anyone else, in Mussoorie. Since Mr. Clarke's "Review" was published, Colonel Beddome seems to have given up *C. Dalhousiae* as a South Indian plant.

Blanford says—"Quite distinct from *C. farinosa*, and subject to little variation. Its range" (in the Simla Region) "is from 7800' to the highest visited (10,500). It appears to be restricted to the Himalaya, and is most abundant in the N.-W. Himalaya. In Sikkim it appears to be rare, but Sir J. D. Hooker gathered it at 10,000' on Lachely" (Lachen Vy. ?), "and Mr. Levinge found it growing plentifully on Sinchal close to Darjiling at 8000'. He agrees with me as to its specific value. The following is a description of its distinctive characters :—

"Stipes 2 to 4 ins. long, shorter than the frond, naked or with a few lax spreading scales near the base. Fronds 6 to 9 ins. long, 2 to 4 ins. broad, acute lanceolate, without white powder at any stage of growth. Lower two pairs of pinnae subequal. Segments narrow. Lines of sori interrupted at the sinus. Involucres even, crenate or toothed on the margin, hardly lacerate."

Some of Mr. Duthie's specimens from Kumaun are the largest I have seen—15 in. l. by 7 in. br., without stretching, besides the stipe. His No. 3,644, Kumaun—Forest above Sosa, 9-10,000', mounted in the Kew Herbarium on the same sheet with Beddome's *C. farinosa*, Kaulf., *var. flaccida*, from the Annamallay Hills, Madras Presidency, is said to have—"fronds meally on both surfaces," but as mounted the upper surface is not visible. The mealiness of *Cheilanthes* in Kew has generally been washed off in the process of poisoning.

I would separate, as perhaps a new species, Dr. King's No. 90 from Chumbi in Thibet, Ling-moo-tong, 27-7-84, in the Calcutta Herbarium. The frond is deltoid and tripinnate.

5. *C. albomarginata*, C. B. Clarke in Trans. Linn. Soc., Bot. Ser. 2, I. 456, t. 52; Baker in Ann. Bot., Vol. V., No. XVIII. Bedd. H. B. 94. *C. furinosa*, var. *albo-marginata*, Bedd. Suppl. H. B. 22.

The localities given by Clarke are :—

N.-W. HIMALAYA—KASHMIR, Falconer; Basaoli 5000', C. B. Clarke. Dalhousie 6000', C. B. Clarke. Simla 7000', T. Thomson. Garhwāl 2-9000', H. C. Levinge. Distrib. Nilgiris, *vide* Major Henderson.

The habitats in the Lists, and of the specimens, I have examined are :—

PUNJAB: *Hazara Dist.*—65-8000', Trotter; *Chamba*—Ravi Valley, "common" 4-5000', McDonell; *Kangra Vj. Dist.*—Dharmasala, Trotter; *Kullu*—7-9000', Trotter, Coventry; *Simla Reg.*—6-8500', Hope, Gamble, Blanford, Bliss.

N.-W. P. : *D. D. Dist.*—Mussoorie 7000' and down to about 4000', very common; *T. Garh.*—above Sahla 7500', Gamble; *Kumaun* 4500—5000', S. and W. Naini Tal—Hope, Levinge, Davidson, Duthie, near Sosa 8-9000', Duthie.

DISTRIB.—*Asia*: Eastern Him. (Baker in Ann. Bot., Vol. V.), S. Ind, Madras Presidency—Ganjam and Nilgiris, Gamble, 1884.

"Eastern Himalayas," in the Annals of Botany, is probably merely an addition to the habitats given by Clarke; but, if *albo-marginata* scales be the distinguishing character of the species, *C. albo-marginata* was found long before Clarke's "Review" was published. Gamble's No. 5200, July, 1873, "Old walls, Kurseong, 4500' (below Darjiling)," must be placed here, though, were it whiter on the under-surface, it might perhaps be put under Blanford's *C. anceps*. Gamble's No. 13,886, from Mahendragiri, Ganjam District, Madras Presidency, 4500', March, 1884, and his No. 14,389, from Naduvatam, Nilgiris, 6000', June, 1884, have perhaps the most characteristic scales of any I have seen, though the shape of the former number is rather that of *C. anceps*.

The name *albo-marginata* I have always thought a somewhat misleading one: the character which seems to have suggested it is merely—"white margined scales." And even this is hardly correct: the scales are brown in colour—dark in the centre, and paler at the edges—bicolourous, in fact. Blanford's *C. anceps* also has bicolourous scales, as opposed to the self-coloured scales of *C. Dalhousiae* and *C. furinosa*; but no one seeing these four plants growing, as I have, would think of uniting them, or even of making three of them varieties of the fourth. The four ferns are distinct and easily distinguishable each from the other.

*Cheilanthes albo-marginata* is undoubtedly a good species, though it has hardly been adequately described by its author. I will not intrude with a revised description: Blanford has given one, and Beddome another; but I may indicate where revision seems necessary. Clarke's plate gives the shape of certain fronds of the plant, but the frond is not, as he says, lanceolate, the lowest pinnae being much the largest. The sequence in growth of the fronds is rather complex;

small, very coriaceous fronds, very dark-green above, whitish and densely scaly beneath, remain expanded or curled up through the winter and succeeding hot dry weather,—uncurling when the rainy season sets in. Then, much larger, herbaceous, fronds spring up, the cutting and colour of which is at first very beautiful; and in the Autumn very large fronds are found, with a coarser cutting, which wither light-brown or yellow, and seem to have a greater proportion of lamina, and are almost membranous in texture. Fronds quite similar to these last, though smaller, are found in *C. rufa*. I do not know when the small coriaceous persistent fronds (described above) found remaining the next season spring up. I have never seen powder approaching to yellow on this fern, but always pure white, though not very dense. Fronds, especially the late, large, ones, are often found without powder; but Mr. Baker is wrong in describing the fern as “denuded,”—if he means denuded of white powder.

Of this species Blanford says—“very abundant in and around Simla, covering the roadside banks and old stone retaining walls. Range from 4800' (my lowest) up to 8500', above which it is replaced by *C. Dallwitzii*. The following is a description of *C. albo-marginata*, which is well represented in the figure, Plate 52, of Clarke's Review, except that the scaliness of the costæ and veins is not fully shown.

“Stipes 4 to 10 ins. long, generally shorter than the frond, bearing throughout dark linear lanceolate scales with pale translucent margins. Similar scales extend to the primary and secondary rachises and costæ. Fronds up to 11-inches long, acute deltoid, under-surface naked, or in the young state and in the small fronds that persist through the dry season, thinly coated with yellowish-white powder. Lowest pair of pinnæ generally the longest. Segments oblong. Lines of sori scarcely interrupted at the sinus. Margins of involucres highly lacerate.

“It is always readily distinguishable from the other allied forms by the presence of scales on the veins and costæ, and by the highly lacerate involucres.”

6. *C. dubia*, n. sp.—Plate II. (see Part II, p. 528.)

Sub-genus—*PHYSAPTERIS*, Presl.

7. *C. Szovitzii*, Fisch. and Meyer; Syn. Fil., 139; C. R. 454; Bedd. H. B. 89.

AFGHAN.: Kabul (Clarke in “Rev.”).

TRANS-IND. STATES: *Chitral*—4500', Harriess; “near Baraul, 5500', Griffiths.”

KASHMIR: *Baltisthân*—5-7000', frequent; *Gilgit Dist.*—7000', Col. Tauner, 1880; *Kishtwar*, 5000', Clarke, 31,336, 17-9-'76; Shagartang Valley 9-10,000', Duthie, 1892; Srinagar—5-6000', Levinge, 1875; Martand Ruins, Levinge, 1875, McDonell, 1891; Takhti-Suliman Hill, near Srinagar, 63-6500', Trotter, 1888, Gammie, 1891.



PUNJAB : Peshawar Hills, Major Vicary, in Herb. Hort. Kew. *Chamba*—"common at 5000'," McDonell ; *Pangi*—McDonell ; *Kullu*, Edgew. ; *Lahaul*—10,000', Watt.

DISTRIB.—*Europe* : Italy and Dalmatia. The Caucasus. *Asia* : Asia Minor Persia, Afghan., Baluchistan, N. Ind.—Sind. Thibet 7-8000'. *Afr.* Algeria.

Clarke says of this species—"Exceedingly like *C. fragrans*, and only to be distinguished by the indusial hairs. The hairs are really confined to the sori, which occupy a very large portion of the very small segments, so that the lower surface of the frond appears densely matted." But in the *Synopsis* *C. fragrans* is No. 16, and put under the subgenus *Euchælanthes*, while *C. Szovitzii* is No. 39, and placed in *Physapteris*, which has smaller segments.

Sub-genus—ALEURITOPTERIS, Fée.

### 8. *C. rufa*, Don ; Syn. Fil. 141 ; C. R. 457 ; Bedd. H. B. 94.

PUNJAB : *Chamba*—3500', McDonell.

N.-W. P. : *D. D. Dist.*—In the Dûn, and on the Hîmalâya 25-5000' ; common low down ; *T. Garh.*—Mussoorie and Chakrâta Road 4500' ; Hope ; *Kumaun*—near Phurka 6500' ; S. and W. Kâli Valley—2-4000' ; Duthie ; Gola Valley, about 4000' Hope.

DISTRIB.—*Asia* : N. Ind. (Him.), Sikkim, 5,000' ; "rare, as is limestone," Clarke. Assam—Khasia 4000' ; "plentiful wherever there is limestone." Clarke. Burma—Mergui. China—Yûnnan 5400' ; "very rare," W. Hancock, 1893.

Clarke says—"I have collected much of this fern, but only on limestone ; it is generally closely procumbent, curling up on the rock, and easily recognised by its woolly hairiness. Scales often none, or undistinguishable from the hairs ; scales, when present on the stipe mixed with the hairs, are narrow-linear, uniform-coloured. Fronds above laxly flocculose or woolly, or almost tomentose." I find that the scales, near the base of the stipe at least, though narrower and longer than those of *C. albo-marginata*, are quite as bi-coloured. The plant curls up only if withered, or in dry weather ; when growing, or in damp weather, its fronds are patent. I think that like some other ferns it is hygroscopic, and uncurls again in wet weather. The lowest pair of pinnæ are always shorter than the next superior pair are, and on them the lowest pinnules are produced, and sometimes pinnatifid ; and sometimes the frond diminishes in width gradually from the middle. The upper surface cannot be said to be tomentose, but there are scattered hairs on it : the stipe and rhachises and under surface are notably tomentose, and the involucres also, I think. The involucres are as rufous as is the tomentum. In the Dehra Dun the plant grows on sandstone, of Siwâlik formation, and, on the slope of the Himalaya, on shale : higher up—perhaps on magnesian limestone. The dimorphism I have alluded to under *C. dubia*. On again going over my specimens—the description of *C. dubia* having been written four or five years ago—I think that *C. dubia* inclines rather to *C. rufa* than to *C. albo-marginata* ; but if the two first-



mentioned plants are to be considered as one there is no gain, in beauty at least, to *C. rufa*, as the *dubia* form is very rough and coarse,—late in the season at least: some specimens almost wholly cover my 'hects—18"  $\times$  12". Taking large, whole plants of each species, they are all three distinct; but individual fronds might be culled to match from all three.

9. *C. farinosa*, Kaulf.; Syn. Fil. 142; C. R. 457; Bedd. H. B. 92.

KASHMIR: Jhelam Valley—"between Chakota and Domel, not common," MacLeod, 1891; Kaman Goshi 3000', Tawi Valley 4000', Gammie, 1891.

PUNJAB: *Hazára Dist.*; (Trotter in M.S. List). *Salt Range*—Tilla Mt., Aitch., 1870, *Chamba*—Ravi Valley 8000', McDonell; Kangra Valley District, W. 2500', E. 4500', Trotter; *Simla Reg.*, near Simla 6500', Kotgarh Road, 45 miles E. of Simla, 9000', Gamble; Simla—Samal Valley 5000', Blauf.

N.-W. P.: *D. D. Dist.*—Siwálik Range 1-3000', abundant along road through Mohand Pass, and probably everywhere else; in the Dún, and up to above 4000', on the Himalaya, abundant; *Saharanpur Dist.*—Siwalik Range; *T. Garh.*—Ganges and Jumna Valleys; *Kumaun*—common 2-4500', near Pitoragarh 5-6000', Kali Valley 9-10,000', and between Gini and Munshiari 7000', Duthie.

DISTRIB.—*Amer.*: Mexico (up to 8000', Guatemala, New Grenada, Brazil. *Asia*; Arabia; N. Ind. (Him.), Sikkim, Bhotan; Assam—Khasia; Bengal—Chittagong and Chutia Nagpur; Centr. Provs., Pachmarhi 3060'; Centr. Ind.—Bagelkhand to Rajputana. S. Ind.—whole Deccan and Madras Presidency in the plains, and up to 3000 on the hills. Burma—Moulmein. Ceylon. Malay Penin. Java. Philippines. *Afr.*: Cameroon Mts., Angola, Zambesi Land, Abyssinia, Bourbons.

The texture of this fern varies from almost membranous to coriaceous and very heavy. I agree with Mr. Clarke, that it is easily separable from *C. rufa* and *C. albo-marginata*; but he might have gone further and have said that it has no resemblance to either, beyond being of the same genus.

In his "Summary of New Ferns" (Ann. Bot., Vol. V.) Mr. Baker refers to the late H. F. Blanford's paper on "Silver Ferns of Simla" read before the Simla Natural History Society, June 25th, 1886, for an account of the Indian forms of *C. farinosa*, and says he cannot separate specifically *C. anceps* and *C. grisea* therein described as species. But Mr. Blanford modified his views afterwards, and in his "List of the Ferns of Simla," Journ. Asiatic Soc. Bengal Vol. LVII, Part II., No. 4, 1888, gave those plants as merely varieties of *C. farinosa*. This is what he said of the type plant in the latter mentioned paper:—

"This is very abundant in the Siwálíks and Doons, and in the deeper valleys of the outer Himalaya up to 4000'. In the neighbourhood of Simla it may be found as high as 5000', above which I have not met with it. The following characters distinguish it from other allied forms. Stipes up to 12 ins. long, generally longer than the frond, deep red-brown, naked or with a few linear scales near the base only.

Frond deltoidly lanceolate, acute to acuminate, up to 8 ins. long and 5 ins. broad, always thickly coated beneath with white powder. Lowest pair of pinnae always the largest. Segments narrow. Sori continuous round the sinus. Margins of involucre entire, uneven, or toothed, not lacerate.

"This form ranges all over India. I have collected it at Pachmarhi at 3000', and I have specimens from the Khasi Hills at 3-5000' and from the Nilgiris up to 6000'."

I found this fern abundant in the Rewa State of Central India, in 1860-61. It seemed to be common along the north edge of the plateau, at the heads of the valleys running down thence northwards. And I have a sheet on which is a ticket of Mr. Clarke's—" *Cheilanthes farinosa*, Central India?" One plant of this is exactly small *C. anceps*, Blanf.

10. *C. anceps*, Blanf., in "The Silver Ferns (*Cheilanthes*) of Simla and their Allies," read before the Simla Natural History Society, 25th June, 1886. *Cheilanthes farinosa*, var. *anceps*, Blanf. in Journ. As. Soc. Bengal, Vol. LVII, Pt. II., No. iv, 1888; Cl. and Baker, in Journ. Linn. Soc. XXV. 411; Bedd. Suppl. H. B. 21, under *C. farinosa*.

"Stipes thick, up to 8 ins. long, little longer or shorter than the frond, dark chestnut to almost black, bearing, generally throughout, dark linear-lanceolate scales, with pale margins, which often extend to the principal rhachis but not beyond. Frond lanceolate to oblong-lanceolate. Under surface always thickly coated with white powder. Lowest two or more pairs of pinnae subequal, rather distant. Involucre narrow, with toothed or lacerate margins.

"Readily distinguished from the typical form by the shortness of the lowest pair of pinnae, and the greater extension of the scales. In large well grown fronds the lower three or four pairs are nearly equal, and the form" (shape?) "of the frond approaches that of *C. subvillosa*. Specimens collected by Mr. Clarke in the Khasi Hills present the same characters as those of the N.-W. Himalaya. I have specimens also from Mt. Abu (Rajputana), collected by Dr. King, and from the Nilgiris at 4000' and 6000', collected by Mr. Gamble."

The above is Mr. Blanford's description of var. *anceps* in the Journal of the Asiatic Society Bengal. As to habitat, he said :—

"In the North-West Himalaya it has a well defined, but restricted range of elevation, viz., from 3500 to 6000 ft., and is common below Simla between 4500 and 5000 ft.

Other records are :—

PUNJAB : *Kullu*—Inner Seoraj, 5000', Trotter.

N.-W. P. : *D. D. Dist.*—Jansar, near Lohwa, 4000', Blanford, 1886 ; near Rájpur 28-4000', plentiful, Hope ; Landour, 6500', Miss Parrott.—Mussoorie-Chakrata Road, 4500', Hope ; *Kumaun*—7000', Duthie ; 4500' Hope, Trotter, Gori Ganga Valley—Bugdiar 8500', MacLeod.

DISTRIB.—*Asia* : N. Ind. (Him.) Sikkim—Pankabari 3000', *Clarke*, 1884 ; Assam—Khasi Hills 5000', frequent, *Clarke* ; Rajputana—Mt. Abu, King, Duthie. S. Ind.—Madras Presy., Nilgiris 4-6000', Gamble. "So common on all the mountain ranges in India," *Bedd.*, Supp. H.B.

I feel obliged to set up this fern as a species (though the late Mr. Blanford, its author, latterly degraded it to the rank of a variety of *C. farinosa*), because I think it very distinct, though the specimens I group here, following Blanford, differ considerably from each other. My specimens collected near Simla, in Blanford's company, are small and not stout, and seem nearer his *var. grisea* than to the large, stout fern which is got on the lower slopes of the Mussoorie range of the outer Himalaya and in Kumaun, and which in thickness and blackness of stipe resembles specimens from other parts of India ticketed *C. bulbosa*, the stipe, however, being much more scaly than the stipe of that fern, and the frond longer and narrower. The scales on the large form are bi-coloured, but those on some specimens of the small form are not so. The involucre on Miss Parrott's Landour fern, gathered in September, are of reddish-brown colour ; and in that respect, and in general habit the plant is almost the same as a plant of *C. grisea* gathered by Blanford in the Simla Region in the same month.

On the way up the Himalaya from Rajpur to Mussoorie *farinosa* is the only *Cheilanthes* seen for the first few hundred feet of elevation : then *anceps* begins to appear, and very soon entirely supersedes *farinosa* and is alone until, with a little of *rufa*, it meets the lower limit of *albo-marginata*. The large form of *C. anceps* is, however, met with also considerably lower down, in the Raspana Valley. The marked difference of *anceps* from *farinosa* at once catches the eye : it is stiffer, and much darker in colour, and the frond is narrowly lanceolate. The coat of farina on the under side is much thicker, and therefore looks much whiter than that on *farinosa*, and it presents a marked contrast to the dark-coloured rhachises. The colour of the frond is a dark-green. If the large stout form is to be put with *C. bulbosa*, Kze., it seems to me to be all the more necessary to make a distinct species of them ; but the shape of the frond seems different in the two plants. I am inclined to transfer Blanford's Simla, high-level type, and the similar small plants from elsewhere, to *C. grisea*.

11. *C. grisea*, Blanford in "The Silver Ferns" (*Cheilanthes*) "of Simla and their Allies," read before the Simla Nat. Hist. Soc., 25th June, 1886 ;

*C. farinosa*, Kaulf., var. *grisea*, Blanford in Journ. Asiat. Soc. Bengal, Vol. LXVII, Pt. II, No. 4, 1888; *C. farinosa*, form *minor*, Cl. and Bak. in Journ. Linn. Soc., Vol. XXV, p. 411; Bedd. Suppl. H. B. 21.

"Stipes slender, 2-6 ins. long, light-brown, naked, or bearing a few thin brown and translucent lanceolate scales (not white-margined) near the base. Fronds dimorphous :—one form narrow lanceolate 4-5 ins. long  $1\frac{1}{2}$ -2 ins. broad, thin papyraceous : lower 3-4 pairs of pinnæ subequal distant : under surface thickly coated, upper surface sprinkled with white powder : segments narrow oblong. The other form ovate-lanceolate : pinnæ close, triangular ; lower two pairs equal. Both forms fertile. Involucres as in typical variety."

PUNJAB : *Chamba* ; Rávi Valley, 8500', McDonell. *Simla Reg.*—Gt. Thibet Rd. from Nagkanda to Bági, and Hattu Mt., 83-9400', Blanf., Trotter, Bliss ; *Simla*.—The Waterfalls, Bliss.

N.-W. P. : *D. D. Dist.*—Mussoorie, about 6200', Hope, 1881 ; *Brit. Garh.*—Dombitía Gadn, 9-10,000', Duthie ; *Kumaun*—above Sosa, 9-10,000' ; Byáns—Káli Valley, above Chálek, 11-12,000', Duthie.

DISTRIB.—*Asia* : N. Ind. (Him.) Sikkim—Darjiling, Sinchal, 8,000', Gamble. Assam—Khasia Hills, Nunklow 2500', Clarke No. 45686.

McDonell's plant from Chamba is very elegant ; stipe twice as long as the frond, which is very white beneath ; involucres light-brown. Bliss's specimen from Bági, No. 243, is similar but smaller, and stipe not so long ; and mine from Mussoorie is the same, but with numerous sharp-pointed scales extending half-way up the stipe ; it, as well as Trotter's from the Simla Region, has a little of the white powder on the upper surface, but in such cases the " powder " may have fallen from the under surface of other fronds. Blanford's and Bliss's specimen from the low elevation, as well as Duthie's from B. Garhwal, have yellow-brown involucres. The powder in all cases is white.

(To be continued.)







J. N. Fitch del.

DAVALLIA CLARKEI Baker.

A. C. Mankerjet lith.

- 1 Frond with rhizome, natural size.
- 2 Portion of a large frond, young state.
- 3 Scale from stipes of No. 3.
- 4 Cells of central portion of No. 4, enlarged about 30 diam.

- 5 Rhizome and base of stipes from another frond.
- 6 Scale from do.
- 7 Cells of central portion of No. 7 enlarged about 30 diam.



## THE FERNS OF NORTH-WESTERN INDIA.

Including AFGHANISTAN, the TRANS-INDUS PROTECTED STATES, and KASHMIR: arranged and named on the basis of Hooker and Baker's *Synopsis Filicum*, and other works, with New Species added.

By C. W. HOPE.

(Continued from Vol. XIII, page 251.)

PART III.—THE GENERAL LIST.—(continued.)

Ord. FILICES.

Sub-Ord. III.—POLYPODIACEÆ.—(continued.)

Genus 13.—**ONYCHIUM**, Kaulf.

1. **O. auratum**, Kaulf. ; Syn. Fil. 143 ; C. R. 458 ; Bedd. H. B. 96.

PUNJAB : *Simla Reg.* ; in Herb. Brit. Mus. a sheet marked—"Simla, Griffith," a pair of fronds, barren and fertile, without stipes : no ticket.

N.-W. P. : *D. D. Dist.*—Jaunsar—near Road from Jumna R. to Chakrata, Mrs. J. Sladen 1880 ; "The Attie Farm" 1500 ? Mackinnons 1878 ; near bridge over Tons R. 1800 ? Mackinnons ; Rajpur—above Tollbar 3400', V. A. Mackinnon 1886, Hope 1887 ; Rajpur below 3000', Gamble, V. A. Mackinnon, Hope ; *Kumaun*—Griffith, *vide* Sir W. J. Hooker's writing on sheet in Herb. Hort. Kew : there is also a small ticket with the single word "Kumaon" in ink and "?" in pencil : one plant, all infertile ; *Gorakhpur Dist.*, in a well in forest, Angus Campbell 1887.

DISTRIB.—*Asia* : N. Ind. (Him.), Nepál, *Wallich* ; Sikkim and Bhotan ; Assam "common" ; E. Bengal 0-4000', sometimes far from the hills, Chittagong ; Burma ; Malay Penins. and Isles ; N. Guinea, *Fitzgerald* 1895 ; Formosa, Henry ; China Yunnan, *Hance* 1893.

The Gorakhpur Station seems to be the only known one between the Dehra Dun and East Nepal or Sikkim, unless Griffith got the plant in Kumaun. A plant named *O. auratum*, in the Calcutta Herbarium, got in Kumaun by Mr. A. O. Hume, is *O. japonicum*, Kze. In the Dun *O. auratum* grows of various sizes, depending upon situation. The situation above Rajpur was dry, shaly rock exposed to the sun ; and a plant I gathered there has perfect tripinnate, fertile fronds, though the whole plant is only  $2\frac{1}{2}'' \times 3\frac{1}{2}''$ . Mr. Mackinnon afterwards found larger plants near that station, but in soil. Mrs. Sladen's Jaunsar specimens also are small.

2. **O. japonicum**, Kze. ; Syn. Fil. 143 ; C. R. 459 ; Bedd. H. B. 96.

PUNJAB : *Chamba*—near Dalhousie, McDonell, Blauf. ; between Chamba town and Kajiár 5000', "abundant on a bank," Trotter ; *Mandi State* 5-7800', Trotter ; *Kullu* 5-7000', Trotter ; *Simla Reg.*—Simla ; the Glen, Bliss 1890 "very rare" : "It has been found near Mashobra, at about 6000" (Blauf. in List).

N.-W. P. : *D. D. Dist.*—Mussooree and Landour, 5-6000', not common, Mackinnons, Duthie, Hope, J. R. Reid ; "*Garhwal*," T. T. 1845 ; *T. Garh.*—Thadiár 3000', Gamble. *Kumaun*—Phurka and Karim 6300', S. and W. ; Davidson, A. O. Hume, near Askot 4-5000' Duthie, near Pithoragarh 5000', Trotter, Rámanga Valley 5-9000', McLeod : "grows in dense grassy undergrowth"



DISTRIB.—*Asia*: N. Ind. (Him.) Nepal; Sikkim 9-10,000', common; *Assam*—Mishmi and Khasia 3-6000'; *Burma*—Ava, Java, Japan, China. Timor II. *O. Forbes*.

Clarke says—"Tufted," but his own specimens in Kew have a creeping rhizome, with distant stipes, and I have never seen the plant otherwise furnished. The mistake was corrected in Clarke and Baker's paper, Jour. Linn. Soc., 8th Aug., 1888, where the authors say—"Rhizoma semper longe-repens, mediocre nec crassum, frondibus remotis; in var. *multisecta* rhizoma omnino idem."

In Kew there is a specimen, on the same sheet with others from Nepal and Japan, marked by Mr. Baker—"Wild at Bott Head, Salcombe, Devon, *John Luscumbe*, Alvington, Torquay, recd. 1-72." This of course must be a case of introduction.

3. *O. contiguum*, Wall. (under *Cheilanthes*), Cat. 72. *O. japonicum*, Kze., var. *multisecta* (sp.), F. Henderson, MS. (*Cheilanthes contigua*, Wall. Cat., 72, *Leptostegia lucida*, Don., Prod. Fl. Nepal, 14), C. R. 459.

KASHMIR: Rattan Pir 8000', Trotter 1888; Pir Panjal 8000', Gammie 1891: marked *O. japonicum* var.

PUNJAB: Hazara Dist., Black Mt., between Sambalpat and Nimmal 7-8000', Duthie, 1888, Machpuri Mt. 9000', Changla Gali 8000', Trotter 1890. *Chamba*—Dalhousie 7000', Clarke 1874, McDonell; *Kangra Valley Dist.*—Dharmasala 8000', Trotter; *Mandi State* 6-10,000', Trotter; *Kullu Edgew.*, Trotter 7000'; *Lahaul*—Capt. Hay 1856, in Herb. Hort. Saharanpur; *Simla Reg.*—Simla, Griffith, T. T., Col. Bates, Dr. Bacon, Lady Dalhousie, Gamble, Hope, Bliss and Blanf., who says—"one of the commonest Simla ferns, growing abundantly, on the ground, both in forest and on the open hill-side. It has a creeping root-stock. The range at Simla is from 6000' to 9000'."

N.-W. P.: *D. D. Dist.*—Jaunsar—Rupin Valley 4500', C. G. Rogers, Mussooree, 6-7000', common; *T. Garh.*—Aglar Valley, Duthie; *Kumaun*—Jacquem., Wallich (R. Blink.), Edgew., S. and W., Davidson, Trotter, MacLeod.

DISTRIB.—*Asia*: N. Ind. (Him.) Sikkim, *Hook-fil.* China: Yunnan, *Delavay*.

Colonel Henderson does not appear to have written a description of this species, but he defended it in a letter preserved in the Kew Herbarium. The description in Clarke's 'Review' is as follows:—

"Fertile frond very finely cut, often 5-pinnate; ripe capsules straw-coloured, not numerous: involucre remaining closed over the ripe capsules."

And the remarks are:—

"Frond herbaceous, hardly shining, not coriaceous. This is more easily separated from *O. japonicum* type than is *O. auratum*, and has been estimated a species both by Wallich and F. Henderson, to whose opinion the area lends support. But if it is estimated a species, I do not know to which the next variety should be attached."

This next variety Clarke calls *intermedia*, and describes thus :—

“ Frond lax, more coarsely cut, involucre often  $\frac{1}{2}$  inch—*O. lucidum*, Bedd., Ferns Brit. Ind., t. 21.”

A specimen, got by Strachey and Winterbottom in Kumaun, at 7500' alt., marked by Clarke as var. *intermedia*, and a few others so marked—among them one got in Sikkim—Lachen 9-10,000', by J. D. Hooker—are, for me, typical *multisectum*. Mr. Clarke says—“ This form, exactly figured by Colonel Beddome, seems half-way between *O. japonicum*, Kze., and *O. multisectum*, F. Henderson. And he adds—“ After going through the Kew material with me, F. Henderson would still prefer to make *O. multisectum* a species.” After reading this, Beddome, in his Handbook, said that his t. 21 was taken from *multisectum*, and that the two varieties of *O. japonicum* differ very slightly, if at all. A variety which, its author says, is exactly figured by another author, but which that other author says he figured from a specimen of another variety, may safely be said to be non-existent. I have collected specimens of *O. multisectum* from uncongenial localities, comparatively small and narrow, and even with brown instead of straw-coloured involucre, but I have attributed their differences from the full-sized plant grown in good soil solely to circumstances. There is really no passage from *multisectum* to *japonicum*, and if there were, I should prefer to make the latter a variety of the former, because—in the North-West Himalaya at least—it is much the rarer. That *O. multisectum* has been the later recognised plant is no reason for holding that it is a variety of *O. japonicum*. Clarke and Baker may be right in saying, in their joint paper of 1888, that the rhizomes of the two ferns are altogether the same; but I think that the fronds of *O. multisectum* generally spring up closer together than those of *O. japonicum* do, as they often form dense bushes, or even beds,—as in Simla, where this fern carpets the ground under the Deodars, and even in the open. I have a tuft, from Tehri Garhwal, collected by Duthie, with 5 or 6 fronds in a mass, mounted on one sheet. And it is generally impossible to spread out even a single frond, in pressing it, so that all the pinnae shall be separate and distinct. *O. japonicum*, in N.-W. India, is a shy, solitary plant: *O. multisectum* is bold and gregarious. In one of the few stations for it I have seen in Mussooree *O. japonicum* was growing inside a thorny bush; and Major MacLeod writes that in the Ramganga Valley, Kumaun, it grows in dense grassy undergrowth. Barren fronds are, perhaps, the more numerous, but I do not think there is any dimorphism. Nor do I find any dimorphism in *O. multisectum*, though Clarke begins his description with—“ Fertile frond very finely cut.”

Clarke says of *O. multisectum*—“ Ripe capsules not numerous.” I should say that the capsules generally ripen, and that most fertile fronds are very

fertile, and that all the pinnæ bear capsules on every segment, except at their apices, and at the apices of each pinnule. Taking one pinnule of the lowest pinna of a less than usually crowded frond, 6-pinnate, I count on it 125 capsules. There must be about 500 capsules on that pinna, and probably 4,000 on the whole frond; and I dare say that number is doubled on large fronds.

On a sheet in the Kew Herbarium, from the Himalaya, "Lady Dalhousie" (no ticket), Mr. Baker has written—"a much larger plant than typical *japonicum*."

*O. melanolepis*, Decaisne, got in Arabia, Persia, and Abyssinia, is very like *O. multisectum*, but it is smaller and more delicate.

#### Genus 14. CRYPTOGRAMME, R. Br.

1. *C. crispa*, R. Br.; Syn. Fil. 144; C. R. 459. Bedd. H. B. 98, and Suppl. 23.

AFGHAN.: *vide* Beddome in Suppl. H. B.

KASHMIR: Marbul Pass 11,200' Clarke; 11-12,000' Aitch.; McDonell, Duthie, MacLeod.

PUNJAB: *Hazára*—Makra Mt. 10-10,500' Trotter; *Chamba* 9-10,000' Baden-Powell, McDonell; *Kangra Valley Dist.*—Dharmasála, 11,000' Clarke; *Lahaul*—Rohtang Pass, 12-13,000' Trotter; *Simla Reg.*—near Phagu, Vicary 1831,—“above Simla,” Col. Bates. The Chur Mt., Edgew., 1836 (very long); Hattu Mt., and vicinity, 8,500-10,000', Gamble, Blauf., Hope, Bliss; *Bisahir*—Kunawar, 9000', Lacc.

N.-W. P.: *T. Garh.*—Cháchpur Peak, 10,000', Gamble; 11-12,000', Herschel, Duthie; *Brit. Garh.*—12-14,000', Duthie; *Kumaun*—“In *Alpibus summis Kumaun*, legit Rob. Blinkworth, 1826” (Wallich's writing on ticket on sheet of *C. Brunoniana*, Wall., in Herb. Hort. Kew); near Rálam 12,000', S. and W. 10-11,000', Trotter, MacLeod.

NEPAL—W. 11-12,000', Duthie.

DISTRIB.—The “Synopsis Filicum,” following Hooker in the “Species Filicum” recognises three forms—*α. C. crispa, European*: distributed from Arctic Europe to Lake Baikal, Mt. Olympus in Bithynia, Etruria, and the Sierra Nevada; *β. C. Brunoniana*, Wall., *Asiatic*; Himalayas at 10-15,000'; and *γ. C. acrosticoides*, R. Br.—*North American*: from Sitka and Arctic Regions southward to Lake Superior, Oregon and California.

The DISTRIBUTION in Asia is Sikkim—head of Lachen Valley, *Hook-fil.*, Dankera 2,000', *King's* Collector. China—Hupei Prov. *Henry*, Szechwán Prov.—Mt. Omei (summit) *Faber*. Japan—*Faurie*.

Beddome, in Suppl. H. B., says—“Gathered by Prain in the Crater on Barren Island, Andamans.” This is a remarkable instance of isolation, and of an Arctic and Temperate Region fern growing in the Tropics, below 12° N. lat.

I do not make out the differences between forms *α* and *β* pointed out by Hooker and Baker; but in the one locality where I have seen the Himalayan



plant growing there were only isolated plants among the herbage and forest undergrowth; and Indian plants seem never to equal British in size. In England and Scotland *C. crispa* generally grows in the open, amongst boulders, or in the stony talus at the foot of cliffs,—sometimes in such beds as to be distinguishable at a distance because of their bright green colour. In the "*Species Filicum*" will be found descriptions of all three forms which Hooker unites under *C. crispa*, and a discussion of the differences between them. After naming the specimen of Blinkworth's gathering, mentioned above (under *Kumaun*), Wallich went on—"Dediciavi speciem conditori generis immortale, animo cestumatissimo."

"N.B.—R. Blinkworth is one of the plant collectors in the employ of the H. C. Bot. Garden at Calcutta under Dr. W. You may translate this into classical latin if you like." On the paper on which this is written is a "frank," by John Wood, London, February 4th, 1829, to Dr. Hooker, University of Glasgow.

Genus 15. **PELLÆA**, Link., Hooker.

Sub-genus—CHEILOPLECTON, Fée.

1. **P. gracilis**, Hook.; Syn. Fil. 145 (*Pteris Stelleri*, Gmel., oldest name); C. R. 460. *Pellaea Stelleri*, Gmel. (under *Pteris*), Bedd., H. B. 100.

KASHMIR: T. Thomson; Pir Panjal, Dr. Stewart; Baden-Powell; Karakoram, 12,500', Clarke, 1876; above Kilan, 12,500', Aitchison, 1877; MacLeod; Duthie.

PUNJAB: *Hazara Dist.*; Makra Mt. 10-10,500', Trotter; *Chamba* 9-9500' McDonell.

N.-W. P.: *T. Garh.* 11-12,000', Duthie; *Brit. Garh.* 11-12,000', Duthie; *Kumaun*—*Champwa* 10-13,000', S. and W.; 10,000' Stewart; 11-13,000', Duthie; Trotter; Lessar Pass 16,500', MacLeod.

NEPAL—W. 10-15,000', Duthie.

DISTRIB: *N. Amer.*; Canada to Wisconsin, rare. *Asia*: Lake Baikal Region; Siberia; N.-W. Thibet—Balti 9000', *T. T. China*—Peking Mts. 8000', "very rare," Hancock, 1874.

Sub-genus—ALLOSORUS, Reel.

2. **P. nitidula**, Baker; Syn. Fil. 149; C. R. 460. *P. nitidula*, Wall. (under *Pteris*) Bedd., H. B. 101.

TRANS-IND. STATES: *Swat.*—Laram Pass., 7000', Gatacre; *Kohistan*, 6-9000', Duthie, 1888 (while with the Black Mt. Expedition).

KASHMIR: *Poonch*; Chittapani Valley 6000', Lev.; 3-6000', "frequent and plentiful to Chamba," Cl. in Rev.; Kishtwar 5000', Clarke, 1876; Pir. Panjal and Rattan Pir 6000 and 8000', Gammie (very large).

PUNJAB: *Hazara Dist.*—Black Mt. 7000', Oertel 1891; the Gullies 6-7000', and near Kalabagh, Trotter—*Chamba*—Ravi Valley and elsewhere 3500-7000', common, McDonell; *Kullu*, 5-6000', Trotter; *Simla Reg.*—"rocks, Simla," T. T.



N.-W. P. : *D. D. Dist.*—Jaunsar—Rupin Valley 4500', C. G. Rogers; *T. Garh.* 5-8000', Duthie, Gamble; *Brit. Garh.* 5-6000', P. W. Mackinnon; *Kumaun*—Wallich (R. Blink.).

DISTRIB.—*Asia* : Kohistan. China—*Henry, Faber*

I have not gathered this fern, but I possess and have seen numerous specimens, and I have no difficulty in distinguishing it at a glance from *Cryptogramme crespa* and *Pellaea gracilis*, with both of which Mr. Clarke says it has been much confounded : cutting, texture, habit, and colour are quite different. Large plants somewhat suggest *Cheilanthes subvillosa* in cutting ; but the texture and other characters are quite different. Beddome's drawing, F. B. I., ft. 222, does not adequately represent the plant, the fronds being very short and deltoid, and all infertile.

Sub-genus—*PLATIGLOMA*, *Jsm.*

3. *P. calamelanos*, Link ; Syn. Fil. 152 ; C. R. 461 ; Bedd., H. B. 104.

PUNJAB : *Sirmur State*—Tikri, Edgew., 1835.

N.-W. P. : *D. D. Dist.*—Jaunsar 4000', Gamble ; *T. Garh.* 2000', Mackinnons, 4-5,000' Duthie, 4,000' Gamble ; *Kumaun*—Almora 4000', S. and W. ; near Naini Tal, on old Almora Road, Mr. Wilmer, 90th Regt. 1861 (given to Hope on day of collection) ; near Khairna, below Almora, 4-5000', Duthie, J. R. Reid, Mackinnons ; Karan, Ramsukh (Duthie's collector) 1888.

DISTRIB.—*Afr.* : Angola ; Abyssinia ; Somali Land ; Ruhezori Mt. ; Zambesi Land ; Mashona Land—nr. Salisbury, *Boyce* 1896 ; Natal ; Cape Colony ; Bourbon.

Himalayan specimens are only bipinnate, so far as I have seen ; but African specimens are markedly tripinnate, the ultimate segments being distant and petiolate.

Genus 16.—*PTERIS*, *Linn.*

Sub-genus—*EUPTERIS*.

1. *P. longifolia*, L. ; Syn. Fil. 153 ; C. R. 461 ; Bedd., H. B. 106.

TRANS-IND. STATES : *Baraul and Swat* ; 4-6500', Harriss, 8000', Gatacre.

KASHMIR : *Jhelam Valley*—4000' downwards, "common," MacLeod.

PUNJAB : *Hazara Dist.*—Dhamtaur 4500', Trotter ; Rawalpindi, Aitch. *Chamba*, McDonell ; near Dalhousie 4000', Trotter ; *Mandi State* 4500', Trotter ; *Kullu* 6-8000', Coventry ; *Simla Reg.*—3-5000', Gamble, Collett, Bliss.

N.-W. P. : *D. D. Dist.*—Jaunsar—Dharmigadh 4000', Gamble ; in the Dūn 2500', and upward ; on the Himalaya to above 6000' in Mussooree, Hope ; *T. Garh.*—3-5000' Duthie ; *Kumaun* 1800' to nearly 6000', S. and W., Ramsukh, Davidson, Hope.

DISTRIB.—*Amer.* : Florida, Mexico, W. Ind. and Venezuela. *Europe* : Spain, Italy, Sicily, Dalmatia, Greece, Ionian Isles. *Asia* : Lycia, Syria, Lebanon ; N. Ind.—from Trans-Indus, the Punjab and Kashmir to Assam and Chittagong, 0-5000', general and abundant on and near the hills ; plains of Bengal, Chutia Nagpur, and streets of Calcutta. Centr. Provs., Ind.—Pachmarhi. S. Ind.—Madras Presidency, in many localities, *Bedd. H. B.* Malay Archipelago, Java, Pacific Isles. "China southwards to Australia." *Afr.* : Algiers, Egypt, Abyssinia, Socotra ; Cape de Verde Islands southward through Trop. Afr. to Angola, Macalisberg, and Marcaren Isles.

Clarke says—"Perhaps the commonest fern of North India, extending over the plains to every village." I suspect he means this to apply to the Lower Provinces of Bengal. I doubt if this fern can be found in many villages in the dry parts of the North-Western Provinces, though I think I used to see it in Rohilkhand. There is a specimen at Saharanpur from Calcutta, collected by Clarke, and I have seen it growing on the walls of houses there. The fern likes water, and in swampy ground grows to a much larger size than is stated in the Synopsis. In Kumaun I have gathered it with fronds 8 feet long; this was by the bed of a stream, on limestone tufa. But *P. longifolia* will grow on dry cliffs, as it does in Mussooree, at over 6,000' elevation. Baker says—"veins close and fine, usually once-branched." A second branching is very frequent, and in two of my specimens, from Rawalpindi and Kumaun, both infertile, I see that the ultimate veinlets frequently unite before they reach the edge—forming loops.

2. *P. cretica*, L.; Syn. Fil. 154; C. R. 462; Bedd., H. B. 106. *P. lœta*, Wall., Cat. 95.

TRANS.-IND. STATES: *Buraul* and *Swât*, 4-6500', Harriss, Gatacre.

KASHMIR: Clarke in "Rev."; "common Jhelam Valley 4000' down," MacLeod in List; Rattan Pir 6000', Gammie.

PUNJAB—*Hazára Dist.*: Black Mt.—Machai Peak, Gatacre, Trotter (in List of Punjab Ferns). *Chamba*; McDonell (in List); Kajiár 6500', Trotter; *Mandi State* 5-6000', Trotter; *Kullu* 6-8000', Trotter, Coventry; *Simla Reg.*—"very abundant in certain parts of Simla, especially on the Sutlej side of the spur, between 5500, and 6500'. It disappears above 8000'," Blanford. 3500' Gamble, Collett, Bliss.

N.-W. P.: *D. D. Dist.*—Jaunsar—Deoban Mt., Duthie's Collector; Rupin Valley 4500', C. G. Rogers; Mussooree 6-7000', very abundant in places; *T. Garh.*—Phedi 4-5000', Duthie; Brit. Garh. 4-5000', Duthie; *Kumaun* 3000'—8000', S. and W. Hope, Davidson, Duthie.

DISTRIB.—*Amer.*: Florida, Mexico and Guatemala. *Europe*: Corsica and Sardinia, Italy, Crete, Tyrol, Caucasus. *Asia*: Ural, Arabia, Persia; N. Ind. (Him.) Sikkim, *Hook-fil.* 8-9000'; Assam—Kohima 5500', Clarke; Bengal—0-6000', common, extending far into the Plains, as at Dháka and Chittagong, Clarke. S. Ind.—Deccan; Madras Presy.—very common, from sea level up to 8000'. Ceylon. Burma. Malay Penins. Philippines. Fiji and Sandwich Isles. *Afr.*: Abyssinia Natal, Cape Colony, Bourbon.

Clarke says the species is very variable, and he gives an amended description, intended to separate this species from *P. pellucida*, Presl., and *P. crenata*, Sw. I have not seen *P. pellucida* growing, but I can see no resemblance to *P. cretica* in herbarium specimens of it. And *P. digitata*, Wall. (*P. stenophylla*, Hk. and Gr.), which Mr. Baker places as a variety of *P. cretica*, and Clarke as a variety of *P. pellucida* (which does not grow in N.-W. India) is quite distinct from both. I have seen no variation in *P. cretica* except that rarely a fertile frond

has broad pinnæ, and, as rarely, a sterile frond, which normally has broad serrated-edged pinnæ, has some patches of sori on it. The rhizome is creeping: stipes approximate, but in progressive order, not tufted; and the plant forms large beds.

3. *P. digitata*, Wall. Cat. No. 91. *P. stenophylla*, Hk. and Gr., Ic. Fil., t. 130. *Pteris cretica*, L.,  $\beta$ , *P. stenophylla*, Hk. and Gr., Syn. Fil. 154. *Pteris pellucida*, Presl., var. *stenophylla* (sp.), Hk. and Gr., C. R. 463; Bedd., H. B. 107 (as Clarke).

PUNJAB: *Chamba*: McDonell in MS. List of Chamba Ferns identified at Kew: *Simla Reg.*—Mashobra, 7000', below Sipi (Sibpur) 5500', Bliss, 1890, 1891, 1892.

N.-W. P.: *D. D. Dist.*—Mussooree, not uncommon, 5-6000'; near Jharipani 4800' in quantity, Hope; in the Dún in several places from below 2,500' to 3,000', Hope, Gamble; *T. Garh.*, Lev. 1873 (named by him *P. dactylina*, Hook.); Mussooree and Chakrata Road, Hope; *Kumāun*—Bageswar 3000', S. and W. 1848, Trotter 1891; Sarju Valley and elsewhere, "grows in dense shade," MacLeod 1893.

DISTRIB.—*Asia*: N. Ind. (Him.) *Nepál*.

As I have already stated, under *P. cretica*, I consider this fern quite distinct from that species, and also from *P. pellucida*. I therefore give it as a separate species, and Wallich's name, *P. digitata*, being the older, must hold good. Wallich's lithographed catalogue, which, on account of the wide distribution made of the plants enumerated in it with lithographed tickets cut out of it, is held by the Kew and other authorities to be equivalent to publication, is dated (the Preface) 1st December, 1828. The "*Icones Filicum*" of Hooker and Greville, in which the plant was described and exactly figured, was published in 1831. Synonyms therein given are—*Pteris stenophylla*, Wallich MSS., 1829, and *P. angusta*, Wall. MSS. 1825 (non Bory). The habitat cited is—"in Napalia, Wallich, 1818," and it is remarked—"Nearly allied to *Pt. læta* of Wallich's MSS. (from *Nepál*) and the European *Pt. cretica*; but it may be known in both by its quite simple pinnæ and the entire margins." The entry in Wallich's catalogue is "*Pteris digitata*, Wall. in Herb. 1823, Napalia, 1820." Some specimens in the Kew Herbarium are named "*P. digitata*, Wall." in Wallich's own handwriting, and 2 sheets have tickets of Wallich's *P. angusta*, Wall. 1818, but none are marked *P. stenophylla*. The name adhered to in the catalogue, *P. digitata*, must be accepted. *P. læta*, Wall., is *P. cretica*.

Mussooree—unless some still unknown place in *Nepal* is—appears to be the headquarters of the species, and in several localities there and in the neighbourhood it is plentiful. It often grows at the foot of and under rocks and cliffs, in shady places, but in single plants, and never in dense clumps and beds as *P. cretica* often does. The longest and most upstanding plants I have seen



were in the forest behind (east of) Jharipani, the half-way halting place on the road up to Mussooree, alt. nearly 5000', growing in clayey soil away from rocks. I have kept only one of these plants, and find it has about 20 stipes springing in a tuft not so thick as a finger. The stipes of some of the sterile fronds are 15" long, and of the fertile ones 20". Some of the fronds are 1 ft. in length. I have a plant wholly a-pinnate, *i. e.*, all the 12 fronds (there are numerous broken stipes besides) are perfectly simple. The sterile fronds of this plant have stipes up to 5 in. long, and fronds up to 9 in. There are only two fertile fronds: one has stipes 9 in. and frond 9½ in. long. A specimen of *P. pellucida*, Presl., from the Nambur Forest, Mann, is subdimorphous, like *P. digitata*: the fertile frond much the longer, with one pair of side pinnae.

4. *P. dactylina*, Hook., Syn. Fil. 155; C. R. 463; Bedd., H. B. 107.

N.-W. P.; *D. D. Dist.*—Jaunsar, near Deoban 8000', Herschell 1879, 9000', Mackinnons, "between Bodyar and Deoban, Mrs. J. Sladen, coll. for Hope, 1880, Lokandi 8-8500', Gamble 1892 and 1894; *Kumaun*—Pindar Gorge, near Dwáli 8000', Trotter 1891.

DISTRIB.—*Asia*: N. Ind. (Him.) Nepál-East; Sikkim up to 12,000'; Assam—Khasi Hills, 4260'. China—Szechwán Prov., *Faber* and *Henry*, Yünnan, *Delavay*.

Clarke doubts the East Nepal locality, which is that given for a specimen in the Kew Herbarium. If that is not an authentic record—though it is not an improbable one—there is a gap in the distribution between Kumaun and Sikkim. The shorter gap between Jaunsar and Kumaun ought to be filled up.

This fern need never be confused with *P. cretica* and *P. digitata*. It has a long though rather slowly creeping rhizome like that of *P. cretica*, though not so thick; but the stipes are like thin stalks of grass, whereas those of *P. cretica* are comparatively thick and very wiry. I have not seen *P. dactylina* growing, but I possess what Mr. Baker on seeing it pronounced to be a "champion" specimen: it was collected in Jaunsar by the Messrs. Mackinnon. This has a bit of rhizome 4½ inches long, with about 36 fronds springing from all along it, presumably of one and the same year's growth, very few of which are soriferous. This plant is 16—17 in. high: longest stipe 14'', with a frond of only 4 in., fertile. Most of these fronds have a central terminal pinna, on a prolongation of the stipe, and a pinna springing from the stipe on each side, which side pinnae immediately divide each into two, making apparently five pinnae, which spread out. These fronds are really tripartite, the two side parts forking. A frond collected by Mrs. Sladen, has apparently 7 pinnae, the lowest pair forked, making apparently 4, and 3 pinnae taking off together from the main rachis, which is prolonged for nearly half an inch beyond the springing of the lowest pair. I find the same, apparently 7 pinnae, in some of Mr. Gamble's specimens, but also some fronds having apparently 9 pinnae, as the lowest pair split each



into 3, and there are the triplets above. I had, long before seeing this, noted the number of pinnae of this fern as being sometimes 9, but I cannot now find such specimens.

5. *P. quadriaurita*, Retz.; Syn. Fil. 158; C. R. 465; Bedd. H. B., 110.

KASHMIR: Trotter (in list of Punjab Ferns)—Rattan Pir 8000', Gamble: small and sterile: may be young *P. excelsa*, Gaud.

PUNJAB: *Chamba* (McDonell in List); Dalhousie 5000', Trotter; *Kangra Vy. Dist.*—Dharmasala 8000, Trotter; *Mandi State* 6500-7000', Trotter; *Kullu* 6-8000', Trotter, Coventry; *Simla Reg.* 4-8600', common.

N.-W. P.: *D. D. Dist.*—Jaunsar 7500', Gamble; Mussooree and Landour 6-7000', common; *T. Garh.* 3-8000'; Kumaun 4-10,000', in many places.

DISTRIB.—“All round the world within the Tropics, and a little beyond them,” (Syn. Fil.). Amer. from Cuba and Mexico, southward to Brazil. Asia: N. Ind. (Him.) Sikkim, Assam and Bengal (Chittagong) 0-7000' “very common, but not found far from the hills” (Clarke in “Rev.”). Kohima and N. Manipur, Clarke. Centr. Provs. Ind.—Pachmarhi, Duthie. S. Ind.—up to 8000' “very common.” S. China. Japan. Ceylon. Malay Penins. and Isles. Polynesia. Trop. Australia—Rockingham Bay. Afr.: Angola, Zambesi Land, Natal, Madagascar.

The *Synopsis Filicum* gives no varieties of this protean species, but mentions, as synonyms, a number of forms got in various parts of the world. Mr. Clarke has given an “expanded” diagnosis to include what he calls trifling varieties, namely *P. nemoralis*, Hk. and Bauer, *P. aspericaulis*, Wall., *P. pectinata*, Don, *P. pyrophylla*, Bl., *P. spinescens*, Presl., and *P. subquinata*, Wall., and has made interesting remarks about some of them. And besides these he makes three varieties—*major*; *khasiana* (completely bipinnate but graduating into the type); and *Blumeana* (sp.) Agardh, which are not recorded from N.-W. India, and are therefore here disregarded. I may mention, however, that Beddome says Clarke's var. *major* has arched (inarched?) veins and is, therefore, *Campteria binaurita*. According to Clarke, *P. subquinata*, Wall., with 7-5 pinnae only, is not worthy a separate name; but Beddome in the Supplement to his Handbook gives it a prominent place as var. *subquinata*, Wall., with a full description. Specimens so named in Gamble's collection, from Sikkim, except that they are of much thinner texture, and have rather shorter and broader pinnules, are practically the same as the fern got in Kumaun, which I identify as Wallich's plant. Forms of *P. quadriaurita* with setae on the upper side of the rachises and costae are got in the N.-W. Himalaya: and another has an asperous stipes, with stipes and rachises red-coloured. But there is another form beautifully red, with quite smooth stipes. I do not think any separate species could be set up from the N.-W. Indian material; but more in that way might be done with North-Eastern plants, judging from some specimens in Mr. Gamble's collection: one has a stiff spine at the point of each segment.

A Mussooree specimen of the type plant, I got long ago, has 9 ears—3 on each side of the two lowest pinnae, 1 on each of the two next above, and the 9th on one of the third pair. And I have another frond which has a remarkable development: it has deflexed ears on the three lower pairs of pinnae, and abnormally developed inferior lower segments up to the seventh pair; but it has also ears pointing upwards on the superior side of the lowest pair of pinnae, two on each of them. These are not so large as the ears on the inferior side, but yet are about two inches in length, deeply pinnatifid, and fertile like the rest. I have seen a frond collected by Mr. J. Marten, in Chamba, of which the fifth lowest pinna on the left side is prolonged, and as compound (bipinnate) as the frond itself,—the pinnules equalling in size the pinnae of the main frond.

I have not seen on N.-W. Indian specimens of this fern the adventitious buds which are found on specimens from elsewhere, and are mentioned in books. Thinking these to be parasitical growths, I referred the question to Mr. G. Massee, F.L.S., of the Royal Herbarium, Kew, and he kindly looked up the subject, and showed me that Giesenhagen, in "Flora," 1892, says the abnormal growth is due to the presence of *Taphrina Laurencia*, Giesh. A similar growth on *Aspidium aristatum*, Sw., is caused by *Taphrina cornucervi*, Giesh.

6. *P. subquinata*, Wall. Cat. 104. *P. quadriaurita*, Retz., Syn. Fil. 158; C. R. 465. *P. quadriaurita*, Retz., var. *subquinata* (Wall.), Bedd. Suppl. H. B. 23. Plate XVII.

The following is Beddome's description:—

"A small form, 8-10 inches high; stipes stramineous; fronds short deltoide lateral pinnae, often only 1-2, rarely 3-4 pair, with a large terminal central pinna, segments long, nearly equally broad throughout, spreading at right angles from the midrib, lower basal segments of the lower pinnae only slightly enlarged and pinnatifid, or quite entire and uniform with the others.

"Nepál (Wallich), Kumaun 3000', at Bagesar (Strachey and Winterbottom). Lachen Valley, "Sikkim," (Levinge). Mr. Levinge's specimens are more slender than Wallich's type, more papyraceous in texture, and furnished with a broad, white band down the centre of each pinna; it would be a very pretty plant for cultivation."

N.-W. P.: *Brit. Garh.*; (Found among the Mackinnons' ferns, without ticket: they think it was got by Mr. P. W. Mackinnon in B. Garhwal in 1881—3 small fronds stipes incomplete); *Kumaun*—Sarju Vy., Bagesar 8000', S. and W. 1848, (named *P. subquinata* by them); Mandal 6000', Davidson; between Takala and Bagesar, Duthie 1884, No. 3704; Chipla, Ramsukh (Duthie's collector) 1888, No. 8024; Sarju Vy., near Kupkota, 12 miles north of Bagesar 3-4000', Col. E. Swetenham, comm. to Hope 1890; Gori Ganga and Sarju Valleys, 5-7000', MacLeod, 1893.

DISTRIB.—*Asia*: N. Ind. (Him.) Nepál, Sikkim.

In the British Museum in a wrapper—"22, *quadriaurita*—*quinata*, India"—are two old sheets (1829 watermark), without tickets, but enfaced—"Pteris *quinata*, Wall. in Herb.": also a sheet from Duthie, No. 3704 (see above) with 2 fronds which have only 1 pair and a terminal pinna each. And there is a sheet with a ticket—"Pteris *quinata*, Wall., E. Napalia, January, 1818, Goalmulia, Looh." A sheet from J. Smith's herbarium—"Pteris *subquinata*, Wall. Ag. mon. 25 Syn. *P. quadriaurita*, Hk., Nepál, Wallich, Sp. Fil. 2, p. 179," suggests Clarke's *P. subindivisa* from a low level in Sikkim.

The stipes and rachises of this fern are pale straw-coloured to yellowish-brown. All the specimens I have seen have, I think, one large ear on each pinna of the lower pair. The pinnæ are exactly opposite, and the lowest pair, with its ears, forms a flattened, unequally armed, St. Andrew's Cross. All the Kumaun specimens, from Strachey and Winterbottom's time, 1848, to MacLeod's, 1893, agree with Wallich's type, and are identical in every respect, and seem to me quite unlike *P. quadriaurita*.

7. *P. excelsa*, Gaud.; Syn. Fil. 159; C. R. 467; Bedd. H. B. 114.

KASHMIR.—? see under *P. quadriaurita*.

PUNJAB: *Chamba*—Dalhousie 6000', Clarke, Ravi Vy. 7000', McDonell, "common"; *Kullu* 6-8000', Coventry 1894; *Simla Reg.*—Simla 5-6000', Edgew., Bates, Gamble, Collett, Blauf. Trotter, Bliss; Mahasu 7-8000', T. T.

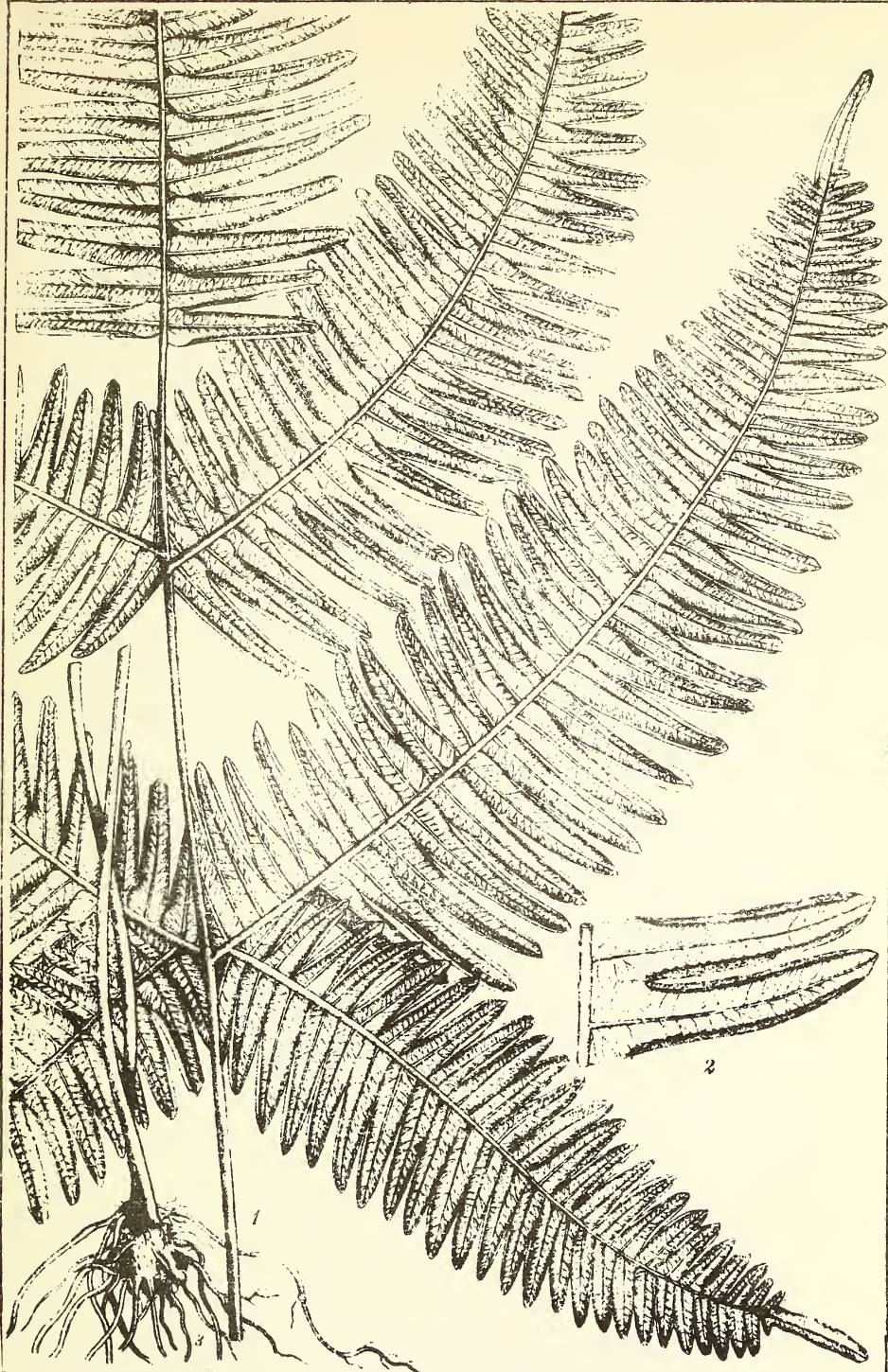
N.-W. P.: *D. D. Dist.*—Jaunsar—Hariana 3000', Gamble; Mussooree 5-6500', not common, Herschel, Mackinnons, Hope; *T. Garh.*—Dhakara 5000', T. T., Herschel; *Kumaun*—Wallich; near Naini Tal 6000', Hope 1861, Lev. 1874, Findar Gorge 7500-5000' Trotter; Gori Ganga Vy. 7000', MacLeod 1893—"only one plant seen."

DISTRIB.—*Asia*: N. Ind. (Him.) Sikkim 8-9000', Sir J. D. Hooker; Assam—Khasi Hills, *Jerdon*, *Godwin Austen*; North Cachar Hills 3500', Mann; Burma, *Wallich*. China—Szechwan Prov., *Henry, Faber*. Philippines. Sandwich Isles. *Hildebrand*, Heller 1895.

Blanford says:—"Very rare" (in the Simla Region). "Apparently restricted to well-shaded spots by the margin of streams. I have collected it in two places at 5500' and 5800', but I have not met with it during the last few years, the original sites having been devastated by wood-cutters and cattle, or exhausted by collectors." But Mr. Bliss has found the plant since then in several localities.

Clarke thinks the Philippine station an error, and the Burma (Ava) one doubtful; but China must now be added as a habitat. I can confirm Clarke's observation that the veins are not rarely 3-4 branched, *i. e.*, a vein is like a tuning fork, each fork forking again, and occasionally these secondary forks unite with each other. In the decurrent bases of the pinnules or segments some veins spring from the rachis and not from the costa, as occurs in many other ferns. On the upper side of a frond I see a short seta or gland at the





J. N. Fitch del.

A. C. Chowdhary lith.

**PTERIS SUBQUINALA Wall.**

1. Portion of a frond, natural size.

2. Segments from a pinna  $\times 2$ .

3. Rhizome and stipes of another frond.





## THE FERNS OF NORTH-WESTERN INDIA.

base of each costa. The involucres are olive-green or olive-brown. The pinnae in large fronds are sometimes almost completely pinnate, but the pinnules are sessile with a broad base. In a frond from the Mackinnons I find the terminal pinna 13 in. l. by  $5\frac{1}{2}$  in. br., and a pair of side pinnae 13 in. by 6 in. The fern loves water.

Sub-genus *PÆSIA*, *St. Hilaire*.

8. *P. aquilina*, L.; Syn. Fil. 115; C. R. 468; Bedd., H. B. 115.

TRANS-IND. STATES: *Barcuil* 7000', Harriess, Gatacre.

KASHMIR: *Gilgit*.—Shankargarh (?) Dr. Giles; Gulmarg, Nagmarg, Sonamarg.

PUNJAB: *Hazara*.—Black Mt., Duthie, near Thandiana 8030', Trotter. *Chamba*; *Kullu*; *Simla Reg.*: common.

N.-W. P.: *D. D. Dist.*; common in the Himalaya, and once seen in the Dún near foot of hills below 3000', Hope; *T. Garh.*; *Kumaun*.

DISTRIB.—“All round the world, both within the Tropics, and in the North and South Temperate Zones, unless it be absent from South Temperate America, from which there are no specimens in Kew Herbarium (Syn. Fil.), *S. Amer.* Brazil, var. *esculentia*. *Europe*: universal, except in the extreme north, and never an Alpine plant: range in the British Isles said to agree closely with that of corn cultivation, and in the Scottish Highlands never above 2000'” (*Britten*, in “*European Ferns*”). *Asia*: N. Ind. (Him.) very common; Assam—Khasi Hills 2-8000', common. S. Ind.—Deccan; Madras Presidency. Burma—Tenasserim. Malay Penins., and Eastward to Australia and N. Zeal. *Afr.*: Cameroon Mts.; Abyssinia.

This fern is so common in the Himalaya that few specimens are to be found in herbariums in the North-West. But I have never seen such thickets and fields of it as are common in the United Kingdom.

Sub-genus *CAMPTERIA*, *Presl*.

9. *P. biaurita*, L.; Syn. Fil. 164; C. R. 469. *Campteria biaurita*, L. (under *Pteris*), Bedd., H. B. 116.

N.-W. P.: *D. D. Dist.*—In the Dún 2000' and upwards, by streams or springs, Mackinnons, Hope; *Garhwal*—Clarke; *Kumaun*—Barmdeo, 900', S. and W.; Gola Valley 3-4000', Hope.

DISTRIB.—The following is the entry in Wallich's Catalogue, under 106, *Pteris nemoralis*, Willd., which is given as a synonym by Clarke, though not by Willdenow himself, who says they are different:—“*Pteris nemoralis*, Wild. species admodum varians.

1. Napalia, 1820, ‘est *Pt. biaurita*’  
(in Hook's writing).

2. Penang, 1822, ‘est *Pt. biaurita*’  
(in Hook's writing).

3. Hurdwar et Dehra Dún, 1825.

4. Montes Avæ, 1826.

5. Montes ad Sylhet, De Silva.

6. Kumaun, R. B.

7. *Pt. biaurita* and *Pt. quadriaurita*.  
Herb. Hegra.”

The plant seems to be found in almost all the warm parts of the globe:—*Amer.*—*Trop.*: from the W. Ind. southward to Brazil. *Asia*: N. Ind. (Him. and Sub-Him. Valleys)—Sikkim and Bhotan, up to 6000'; Assam—Dharang, Khasia 0-6000'. Bengal—extending over the plains to Dháka, Pubna, &c., Parasnáth Mt. 4400'.

S. Ind.—The Deccan and Western parts of Madras Presy. up to 6000', not common. Ceylon. N. Burma and Andaman Islands, Kurz., Malay. Penins. and Isles. Tonkin. S. China. Australia.

Baker, Clarke, and Beddome all say this species differs from *P. quadriaurita* only in the venation; but I must maintain that, apart from the difference in venation, the two species are abundantly unlike, and that no one knowing the two in growth, in N.-W. India at least, could ever mistake the one for the other. The form *P. nemoralis*, Willd., or a form which has both free and inarched venation on the same frond, is got in the Dehra Dûn; and I have one small plant, less than 18 inches in height, altogether without inarched venation, but with forked veins, springing from the rhachis between the segments, which sometimes unite with the lowest costal veins. A large plant from the Dûn has stipes 26 in., and frond 34 in. in length. These are  $14\frac{1}{2}$  pairs of pinnæ, of which the lowest pair is over 12 in. l. by almost 3 in. br.: these are bipartite, the secondary pinnæ being 10 in. l. The terminal pinna is nearly 9 in. by  $1\frac{1}{2}$  in. The lowest pinnæ of *P. biaurita* are, I should say, always bipartite; but I have never seen more than one descending pinnule or ear on each side: Clarke says there are sometimes two or three.

From Selim, below Darjiling, at altitudes of 1,200 and 1,500 feet, respectively, Gamble has two very different-looking plants, both of which he names *P. biaurita*, and both of which are *Campteria*: one has dark-coloured rhachises, 8-10 pairs of pinnæ, and broad, blunt, approximate segments: the other is much paler in colour, with straw-coloured rhachises, 8-15 pairs of pinnæ, with long narrow far-apart segments. This latter is what is supposed to be *P. nemoralis*, Willd., as the veins of contiguous segments often miss connection below the sinus; but it is quite different in cutting, colour, and appearance from my Dehra Dûn specimens above described: the venation only is similar.

10. *P. Wallichiana*, Agardh; Syn. Fil. 65; C. R. 469. *Campteria Wallichiana*, Agardh, Bedd., H. B. 118.

PUNJAB: *Chamöa*—Clarke, McDonell; *Kangra Vy. Dist.*—Dharmasála, Edgw., Clarke; *Kullu* 6-8000', Trotter, Coventry; *Mandi State* 5-6000', Trotter.

N.-W. P.: "*Garhwal*," T. T.; *T. Garh.*, 5-7000', Mackinnons, Ganges Vy. 5-6000', Duthie; *Kumaun*—Wallich, R. Blink. (*Pt. umbrosa*, Wall.), S. and W. (*Pt. umbrosa*) Davidson, Trotter.

DISTRIE.—Asia: N. Ind. (Him.) Sikkim, Bhotán 3-8000'; Assam—Khasi Hills 3-6000', common; Manipur, Clarke. Java. Japan. Philippines. Samoa.

Sub-genus DORYOPTERIS, J. Smith.

11. *P. ludens*, Wall.; Syn. Fil. 166; C. R. 470. *Doryopteris ludens*, Wall., Bedd., H. B. 120.

TRANS-IND. STATES: *Baraul*—Ziarat Valley 5000' and 8000', General W. Gatacre, June 1895.

DISTRIB.—*Asia*: N.-E. Ind.—Assam, Naga Hills, Nichugardh 750' *Clarke*; E. Manipur, Chattick 5000', *Watt*, "very abundant." Bengal—Orissa, Balasore Hills *Blanf.*; Chitagon Hills up to 1000', *Rowburgh, Clarke, King*. Burma, on the Irrawaddy, *Wallich*, "Burma," *Kurz*; Maulmein, *Lobb, Parish*. Malay Penins. Philippines.

Collected by Brig.-General (now Sir W.) Gatacre, when with the Chitral Fort Relief Expedition:—2 sterile fronds only, without rhizome (which should be creeping); one—from 8000' alt., about  $2\frac{1}{2}$  in. l. by barely 1 in. br., entire, cordate-lanceolate, and the other—from 5000', about 4 in. l. by  $4\frac{1}{2}$  br., with two pairs of lateral, oblong, rather bluntly-pointed lobes, the lowest of which has a pair of subsidiary lobes, deflexed. The stipes, main and secondary rhachises are glabrous, and almost black: the veins are hidden in the coriaceous lamina. (See my paper on the "Ferns of the Chitral Relief Expedition," in "The *Journal of Botany*," March, 1896, p. 122). I compared these specimens with sterile fronds of *P. ludens* from the Chittagong Hill Tracts, in Mr. Gamble's collection, and found them identical, though the cutting varies; and Mr. Gamble agreed. The most westerly extension of this species before known is in Orissa, in the Indian Peninsula, in about  $21\frac{1}{2}^{\circ}$  N. lat., and  $86^{\circ}$  E. long., up to 1000 ft. alt. Other known habitats are (in India) the Naga Hills in Assam, at about 750 ft. alt.; the East of Manipur, in about  $23^{\circ}$  N. lat. and  $94^{\circ}$  E. long., at an altitude of 5000 ft. The Ziarat Valley, where General Gatacre got the plant, lies to the south of Chitral, north of the Lowari (or Lowarai) Pass, in about  $35^{\circ} 25'$  N. lat., and  $71^{\circ} 50'$  E. long. Snow must lie in the Valley for many months in the year at the altitude of 8000', and perhaps even down to 5000'.

In "the Botany of the Chitral Relief Expedition," No. 9, Vol. I. of "The Records of the Botanical Survey of India, Calcutta, 1898," I find the following note by Mr. Duthie regarding this fern:—

"In reply to a letter to General (now Sir William) Gatacre asking for further particulars regarding the localities of this very interesting fern, I received the following information:—'This fern was found growing in many places in the Ziarat Valley at 5000 feet, near the Kaffir Rock (about  $3\frac{1}{2}$  miles north of Lowari Pass, on the road), a well known spot by reason of the Kaffirs from Kafiristan selecting this wild spot to set upon and murder caravans passing through the country. The valley hereabouts is a very sheltered spot, a beautiful stream running down the centre, the hills clothed with flowering shrubs, and the valley filled with the white peony. Undoubtedly snow lies here during the winter, even down to 5000 feet, but the place is warm and sheltered from wind; the soil is very rich, and streams from the summits of the hills are always



pouring through fissures into the valley below. This fern was also seen growing in several places on the hill above on the west side of the valley, where water runs out of rocks at 8000 feet. The ground here must be under snow for certainly four months, if not more. There is close by here a crater, apparently of volcanic origin, which may account for the fern being found here, but no difference was perceptible in the temperature of the water." .

Another remarkable westerly and northerly extension of a tropical fern is the case of *Lygodium microphyllum*, A. Br., which also was found by General Gatacre in the Zíarai Valley, at 5000' alt.

Genus 17.—**CERATOPTERIS**, Brong.

1. **C. thalictroides**, Brong. ; Syn. Fil. 174 ; C. R. 471 ; Bedd., H. B. 123.

PUNJAB : "in rice fields"—Edgew. in Herb., Saharanpur. *Chamōa*—Raipur 3000', Clarke ; *Kangra Vy. Dist.* "in rice fields" in Herb. Calcutta ; "*Mundi*" (Mandi State ?) Jacquem. ; *Karnal District*, J. R. Drummond (*vide* Trotter) ; *Sirmur State*—Kíárda Dún (seen by J. R. Drummond, *vide* Trotter).

N.-W. P. : *D. D. Dist.* ; Jauasar—near Kalsi 1500'. Gamble ; D. Dún West, Mackinnons ; D. Dún East—Nakraunda 1900', Hope 1886 ; Raspana R. below 2000', Angus Campbell 1889 ; *Kumaun*, Wallich (or R. Blink.) in Herb. Hort. Kew.

DISTRIB.—"Throughout the Tropics in quiet waters," (Syn. Fil.). *Amer.* : S. Florida, Mexico, and W. Indies southward to Brazil. *Asia* : "Arabia Felix" and S.-E. Arabia. N. India—Nepal, Wallich ; Sikkim Bhotán ; Assam—Goalpára, Mann ; N. Manipur ; 3000', Clarke ; Bengal—Sháhabád Dist. *Lev.* ; Chutia-Nagpur, *Rev. A. Campbell*. Centr. Provs. Ind.—6 stations, *Duthie*. Centr. Ind., Clarke. S. Ind. common (*vide* Beddome). Burma—Great Coco Island, *Dr. Prain* ; Nicobar Islands, *Kurz*. Singapore, Wallich. Java. Philippines. Japan. China. Hongkong. *Afr.* :—W. Trop. ; Angola ; Madagascar.

Beddome's description amends that in the *Synopsis Filicum* as regards the veins, which anastomose distantly in the fertile fronds, and closely in the sterile ones. But I would add that in pressed and dried specimens the whole fertile frond—stipes, rhachises, and lamina—appears homogeneous, and the stipes even is veined. Living plants should be examined as to this.

I have seen this fern in its natural state only in the Dehra Dun. Mr. Angus Campbell and I were on an elephant, picking out a line for the proposed railway from Hardwar to Dehra (since constructed and lately opened for traffic), and on seeing water draining from a swamp I said—"this looks like a place where *Ceratopteris* would grow." I had hardly spoken when I saw bright green patches in the water, and told the "Mahaut" to get down and hand up a sample : it proved to be this fern. Both here and at Mr. Campbell's station, a few miles westward, the plant was of course rooted, as there was a considerable current.

Genus 18.—**BLECHNUM**, Linn.1. **B. orientale**, L.; Syn. Fil. 186; C. R. 474; Bedd., H. B. 132.

N.-W. P.: *T. Garh.*—4000', Mackinnons 1879; *North Oudh*, in forests, R. Thompson 1870.

DISTRIB.—*Asia*: N. Ind. (Him.) Nepal, Sikkim; Assam—Khasi Hills up to 4000', Garo Hills, Bengal—North and East, near the Hills; Chutia-Nagpur—Palāmow, *Dr. J. J. Wood.* Centr. Provs. Ind.—Pachmarhi 3,000', *Mrs. C. Morris.* Centr. Ind. ? *Clarke.* S. Ind. up to 6030', common. Burma—Maulmain, *Parish.* Ceylon. Malay Penins. and Isles. S. China—Hainan, *Hancock.* Polynesia. Australia: Queensland.

Genus 19.—**WOODWARDIA**, Sm.

## Sub-genus ENWOODWARDIA.

1. **W. radicans**, Smith; Syn. Fil. 188; C. R. 475; Bedd. H. B. 135.

KASHMIR: Basaoli 5600', Clarke.

PUNJAB: *Chamba*; McDonell (in List). *Mandi State* 7500', Trotter; *Kullu* 5-8000', Trotter, Coventry; *Simla Reg.* 5-6000' "common on steep, well-shaded banks, close to streams, below 5500'" (Blanf.); Bisahir, Lacc.

N.-W. P.: *D. D. Dist.*—Jaunsar—Thadyar 5000', Gamble; Mussooree 6-6500', not uncommon; *Kumaun*—4-8000', common.

DISTRIB.—*Amer.*: California, Arizona, Mexico, and Guatemala. *Europe*: Spain, Portugal, Italy, Sicily. *Asia*: N. Ind. (Him.) Nepal, *Wullih*; Sikkim, Bhotan, 3-8000'. Assam—Khasi Hills 4-5000', not plentiful; Garo Hills, *Day* Smaarra and Java, Philippines. China: Szechwan Prov.—Mt. Omei, *Faber*; Ichang Prov., *Hancock.* *Afr.*: Azores, Madeira, and Canaries; Congo; Abyssinia.

The description of the genus in the *Synopsis Filicum* is incorrect as to the position of the sori, in *W. radicans* at least: they are not "placed in rows parallel with and contiguous to the midribs of the pinnæ and pinnules." The fern is not bipinnate, and there are no rows of sori parallel with and contiguous to the midribs of the pinnæ. The sori are placed in the segments of the pinnæ, only one sorus on the lower side of a segment being below the sinus. The description in Beddome's Handbook of the species is correct in this respect. In the *Historia Filicum* Smith says of the genus—"Sori oblong, contiguous, forming a sub-costal, medial, row."

Clarke says the Indian form is erect, and not so fine as the pendent plant in Madeira and the Canaries. When it grows to a fair size *W. radicans* cannot stand upright, and if it did it could not root from the buds (one and sometimes two) which are found near the point on almost every frond. In India it often grows on steep banks, as Blanford says, and there is pendent. I have seen fronds up to 8 feet in height, and bending over running water.

Genus 20.—**ASPLENIUM**, Linn.

## Sub-genus THAMNOPTERIS, Presl.

1. **A. Nidus**, L.; Syn. Fil. 190; C. R. 475. *Thamnopteris Nidus*, L., Bedd., H. B. 137.

N.-W. P. : *Kumaun*.—Rāmganga Vy., 2500', S. and W.; Gori Valley, near Askot 3-4000', Duthie's collector; Gori Valley 2-3000', on trees, Duthie.

DISTRIB.—*Asia* : N. Ind. (Him.)—Nepal, Sikkim; Assam, and through the plains of Bengal to the southward of Calcutta, and to Chittagong. *Malabar*a. "Typical *Nidus* has not yet been found in the Madras Presidency" (Beddome in Handbook.) *Burma*—Rangoon. Ceylon, Penang. Tonkin. Borneo. China—Kow Loon, Chusan. Japan—Bonin Islands, Formosa. *Polynesia*—Samoa, Society Islands, New Caledonia. *Australia* :—Norfolk Island, Lord Howe's Island, Queensland. *Afr.* : Mascaren and Seychelle Isles.

A frond in the Kew Herbarium, got by Hooker fil. in Sikkim, is remarkable by having a lobe projecting  $2\frac{1}{2}$  inches beyond the margin of the frond, towards the apex, with a midrib of its own, 4 inches long from the main rachis, with veins and sori normal to it. There is a similar frond in the British Museum, marked "Khasya (?). H. and T."

Sub-genus EUASPLENIUM.

2. *A. ensiforme*, Wall.; Syn. Fil. 191; C. R. 476; Bedd., H.B. 141.

PUNJAB : *Simla Reg.*—Simla 6000', Edgew., Col. Cruikshank, Bliss; Hatu Mt. Dr. Cuttall 1875, Bāgi 9200', Bliss 1891; Bisāhir 5000', Lace 1891. *Karnal District* (in the plains) below 1000', Drummond (*vide Trotter*).

N.-W. P. : *D. D. Dist.*—Jaunsar 5500', C. G. Rogers; Mussooree, Mackinnons, Hope, T. Garh. Vicary 1832, No. 11, in Herb. Hort. Saharanpur; Kedar Kānta Mt. 7-8000', Herschel; *Brit. Garh.* 7-8000' Duthie; *Kumaun* 6-8000'; apparently not uncommon.

DISTRIB.—*Asia* : N. Ind. (Him.)—Nepal, *Wallich*, *J. Scully*; Sikkim and Bhotān, 4-9000', common. Assam—*Griffith*, *Mann*. *Burma*—Tenasserim. S. Ind.—W. Forests of Madras Presidency. Ceylon. *Afr.* : Madagascar, *Mrs. F. Gregory*, in Herb. Hort. Kew.

J. Smith noted on a sheet of Wallich's from Nepal—"Stains paper pink in drying," and Clarke and Beddome have noted this property of the plant; but it does not always do so. I imagine this depends on the age of the fronds, which remain on the plant, I think, for at least two years. The dye penetrates through several sheets of thick paper, and does so for years after the plant has been dried. *Gymnogramme elliptica*, Baker, from the Dehra Dūn District at least, also has this property. Blanford says *A. ensiforme* is very rare in the Simla Region.

3. *A. alternans*, Wall.; Syn. Fil. 194; C. R. 476; Bedd., H. B. 142.

AFGHAN. :—"Alipore," Griffith in Herb. Kew.

TRANS-IND. STATES : *Chitral* 4500'; *Baraul* 5500', Harris; *Swāt* 4000', Gatacre.

KASHMIR : Jacquem., Winterbottom; 7500-8000', Trotter, 7000' Gammie; "common below 4000'," MacLeod.

PUNJAB : *Salt Range*; Mt. Tilla, Aitchison, "profuse"; *Hasdra*—Black Mt., Duthie, Oertel 5000', near Kālapāni 7000', Trotter, Murree, Dr. Fleming. *Chamba*, T. Thomson, McDonell (in List); Dalhousie—Dyas (*vide Clarke*); *Jalandhar* (in the plains?) in a well with *Adiantum Cupillus-Veneris* and *Nephrodium molle*, Aitch. 1876; *Kangra Vy. Dist.* 3-8000', Trotter; *Mandi State* 5000', Trotter; *Kullu* 5-6000', Trotter, Coventry; *Simla Reg.*—"very common from 4-5000' up to about 8000'" (Blanf. in List), Sirmur State, Jacquem.

N.-W. P. : *D. D. Dist.*—In the Dūn 2-3000', and probably lower, common; Mussooree 5-6500' common; Jaunsar—Gamble; "*Garhwal*," Jacquemont; T. Garh. 4-5000'; *Kumaun* 2-7000'.



DISTRIB.—*Asia* : Afghan.; N. Ind.(Him.)Sikkim, rare. Assam—Kbasi Hills 3-4000', Mann ; Manipur, Watt. Rajputana—Mt. Abu, King. *Afr.* : Abyssinia—Schimper.

In the north-east of India, where it is rare, this fern grows larger than in the north-west. Some specimens I have, or have seen, collected by Gamble and Levlige, are so different from others, and from the north-west plant that a variety-monger might make one here. One plant has fronds 11 inches long by  $2\frac{1}{4}$  inches broad, with hardly any stipe. A frond on another sheet is 1 foot long by 2 inches broad, and stipe 2 inches. The cutting of these is very coarse, the segments being broader and blunter than usual, and sometimes sub-crenulated or sub-lobed round the ends of the veins. There is a distinct hyaline (or cartilaginous) margin, which is rarely distinguished in my North-Western specimens. And on some small plants with similar cutting the sori are very short and broad. The large specimens seem to bear the same relation to the N.-W. India form that *A. aureum* of the Canary Islands bears to *A. ceterach* of North Europe ; but intermediate forms might perhaps be picked out. Assam plants of *A. alternans*, in the Calcutta Herbarium, are like those from Sikkim, and the sori are more apical than those of N.-W. Indian plants.

Colonel Beddome says—of the venation and fructification—"veins sub-flabellate, all free ; sori copious on all the lobes in two rows, linear-oblong, erect-patent, the superior basal one parallel with the costa"—parallel with the rhachis of the frond, I presume he means : but his enlarged drawing, while showing the venation fairly, does not show the basal sori he mentions ; and it seems to show that the veins in the decurrent base of the segments spring from the rhachis of the frond and not from the costa of the segment or lobe. This they sometimes appear to do ; but the substance of the frond is thick and opaque, and it is not always easy to trace the basal veins to their origin. The position of the sori depends of course upon the direction of the veins. The segments or lobes are more gradually decurrent on the rhachis on the superior side than on the inferior, and a main branch from the costa runs off, on the superior side, parallel to the rhachis from near the base of the costa, so near in some cases that the off-take is obscure ; and it gives off veinlets towards the margin. This branch and its veinlets are not generally soriferous, and in the lower half of the frond perhaps never so, and then all the sori appear to lie in the segments, and at an angle with the costa of the segment. Higher up the frond basal sori appear, both on the parallel branch vein and on the veinlets which spring from it, and towards the apex of the frond the involucre of the long parallel basal sori open towards the rhachis of the frond, instead of towards the costa of the segment as the segmental sori do. At the apex of the frond, as the segments become confluent, the rhachis becomes the costa of the apex, and the involucre open inwards towards it.





## THE FERNS OF NORTH-WESTERN INDIA.

Including AFGHANISTAN, the TRANS-INDUS PROTECTED STATES, and KASHMIR : arranged and named on the basis of Hooker and Baker's *Synopsis Filicum*, and other works, with New Species added.

By C. W. HOPE.

(Continued from page 461 of this Volume.)

### PART III.—THE GENERAL LIST.—(continued.)

4. **A. viride**, Hudson : Syn. Fil. 195 ; C. R. 477 ; Bedd. H. B. 148.

AFGHAN. ; Kurram Valley, 6-11,000', Aitch. 1879.

TRANS-IND. STATES : Chitral, F. E. Younghusband 1894, Baraul 11,000', Harriss 1895.

KASHMIR : Gilgit.—Col. Tanner 1880, Dr. Giles, Nittar Valley 10-11,000', Duthie ; Tilail 12,000', Clarke ; Gulmarg, &c. ; 12-13,000', Lev. ; Shisamarg, Trotter, 1839 ; Kamri Valley 10-11,000', Duthie 1892 ; Kishenganga Valley 10-12,000', MacLeod 1891 ; below Punji Pass 10,600', McDonell 1893 ; Masjid Valley 13-14,000', Duthie 1893.

PUNJAB : Hazara ; Makra Mt. 10-10,500', Trotter ; Chamba ; Upper Chenab Valley 12,000' (perhaps in Kashmir), Baden-Powell 1879 ; Bandal Valley, McDonell 1882

N.-W. P. : Kumaun—Pindari Glacier 12,000', and near Martoli, S. and W. ; 11-15,000' (7 localities) Duthie ; 11,000' Trotter ; 11-16,000' MacLeod.

DISTRIB.—N. Amer. ; Greenland, Newfoundland, N. Brunswick, Brit. Columbia, Sitka Id., Rocky Mts. (California). Europe :—" Arctic Europe to the Pyrenees ; Dalmatia " (Syn. Fil.). United Kingdom, France, Germany, Bohemia, Italy, Greece, from near sea level to 10,000'.

Mr. Clarke said, in 1880 :—" I find no example from India in the Kew collection " ; and half a sheet from " Kashmir 9-11,000' " is the only material, I think, in the British Museum. There is still a wide gap, between Chamba and Kumaun, from which I can find no record of the collection of this plant.

5. **A. Trichomanes**, L. ; Syn. Fil. 196 ; C. R. 477 ; Bedd. H. B. 144.

AFGHAN : Griffith, Kurram Valley 7-9000', Aitch. ; 7000', Collett 1879.

TRANS-IND. STATES : Baraul 5-10,000', Harriss ; 7-9500' Gatacre.

KASHMIR : Jacquem. ; Gilgit (Trans.-Ind.), Sai 5500', Tanner ; Baltistan—Sátpura Nála 10-11,000', Duthie ; Kashmir 7-10,000', Aitch. ; Kamri and Liddar Valleys, and Tajwás Nála, 6-10,000', Duthie ; Woolar Lake 5500', Gulmarg 9500', Trotter ; Gulmarg 7000', Gammie ; " common 6-10,000' " MacLeod.

PUNJAB : Hazara—Black Mt. 7-9000' Duthie ; 6000' Oertel ; Thandiána 8500', Trotter ; Chamba, 75-9000', McDonell ; Kullu 5-8000', Trotter ; Lahaul 10-11,000', Trotter ; Simla Reg. 55-8000', common. " A very common fern ; from 5 to 9000' " (Blk. in List).

N.-W. P. : D. D. Dist.—Jaunsar, Gamble ; Mussoorie, 6-6500, not uncommon ; T. Garh. 7-11,000' ; Kumaun 6-12,000', very large at 11,000' from Duthie.

DISTRIB.—*N. Amer.* : Sub-arctic Greenland, Canada, and westward to Rocky Mts., Brit. Columbia ; United States ; Bermuda, and southward to Panama ; W. Ind. Islands. *S. Amer.* from Guiana and Venezuela to Bolivia. *Europe* : Brit. Isles ; continent of Europe “ throughout its length and breadth, from Iceland and Lapland to the Rock of Gibraltar ; throughout the Mediterranean Region ; and from the extreme west of Ireland to the extreme East of Europe ” (Britten’s European Ferns). *Asia* : Trans-Caucasus, Persia, Siberia, N. Ind. (Him.), Sikkim (?), Bhotan. S. Ind.—Kulhatty on the Nilgiris *Bedd.* Java. Japan. *Australasia* : Australia, Tasmania, N. Zeal. *Afr.* : Azores and Macaronesian Isles ; Algeria ; Morocco ; Abyssinia ; Semali Land, *Mrs. Lort Phillips.* Cent. Afr.—Ruvenzori Mt., *Scott Elliot.* Cape of Good Hope.

6. *A. septentrionale*, Hoffm., Syn. Fil. 198 ; C. R. 478. *A. septentrionale*, Linn. (under *Acrostichum*) *Bedd.* H. B. 145.

AFGHAN : *Kurram Valley*, 9-11,000, Aitch. 1877 and 1879, “ profuse on rocks ” ; above *Peiwar Kotal* 7000’, *Collett* 1879.

TRANS-IND. STATES : *Baraul* 72-9500’, *Hariss*, *Gatacre*, 1895.

KASHMIR : T. T. ; *Gilgit Dist.*—Dr. *Giles* ; *Lev.* 1872 ; W. S. *Atkinson* 1874 ; *Clark* 9500’ 1876 ; Aitch. 12,000, 1877 ; *Nagmarg*, *Trotter* 1888 ; *Kishenganga Valley* 5-12,000’, *MacLeod* 1891 ; *Sonamarg* 8000’, *Gammie* 1891 ; *Nittar Valley*, the *Kajnáj Range*, and *Astor Dist.*, *Liddar Valley* 7-11,000’, *Duthie* 1892-93.

PUNJAB : *Chamba*—Upper *Chenab Valley* (perhaps in Kashmir), 8-10,000’, *Baden-Powell* 1879 ; *Pangi* 8500’, *McDonell* ; *Lahaul*, *Capt. Hay* 1856 ; *Chandra Valley* 10-11,000’, *Rohtang Pass* 12,000’, *Lahaul* 13,000’, *Trotter* ; *Simla Reg.*—*Kunáwar Jacquem.* *Vicary* 1833 ; *Bisahir*—*Parbani Forest* 9000’, *Lace.*

N. W. P. : *Garhwal*, *Jacquem.* ; *T. Garh.* 7-10,000’, *Duthie* ; *Brit. Garh.* 11,000 S. and W., 14,000’, P. W. *Mackinnon* 1881 ; *Kumaun*—*Vicary* 1831 ; in *Herb. Hort. Saharanpur* ; *Milam Valley* and *Tola* 11,500’ S. and W. ; 10-12,000’—14 localities, *Duthie.*

DISTRIB.—*N. Amer.* : Rocky Mts. and New Mexico. *Europe* : Norway, Sweden, Russia, Brit. Isles to Spain, Italy and Sicily, Caucasus. *Asia* : Caucasian, Ural, and Altai Regions, Siberia ; *Thibet*, T. T. 1857.

My specimens from the *Lahaul Hill State*, collected by Mr. *Trotter*, are ticketed 10-12,000’ altitude ; but in a letter, written while on his tour in those parts, my friend mentioned that he had got the fern at 13,000’. In his privately printed list of Punjab Ferns, Mr. *Trotter* says that the Rev. Mr. *Heyde*, the Moravian Missionary, long located in *Lahaul*, assured him that *A. septentrionale* was found quite up to the snow line, nearly 19,000’ above the sea level. Mr. *Trotter* further says—“ I have collected it in several places from 7,500’ to 9,500’ alt., and it has once been found (*fide* Miss *Farrant*) as low down as the *Baramula Pass* (Kashmir), 6000’. I have never gathered this species except on “ *Arthur Seat* ”, *Edinburgh*, at an elevation of about 300 feet above the sea,— more than forty years ago.

7. *A. unilaterale*, Lam., Ency. II. 305 (1786), the oldest name ; C. R. 481 ; *Bedd.* H. B. 152. *A. resectum*, Smith ; Syn. Fil. 210. *A. unilaterale*, Lam., Baker in “ *Summary of New Ferns* ”, 1891.

PANJAB : *Chamba*.—Dalhousie, Clarke, McDonell (in List); *Kullu*—7000', Trotter; *Simla Reg.*—Simla, 5 stations 5-5000', Gamble, Collet, Blauf., Trotter, Bliss.

N.-W. P. : *D. D. Dist.*—Sowárna Nála, 4500', Mackinnons 1879, P. W. Mackinnon and Hope 1881; *Kumaun*—near Naini Tal, 6000', (?) Hope 1861, between Dandiha and Karela 5-6000', Duthie 1884, Dhankuri to Khati 75-8000', Trotter 1891.

DISTRIB.—*Asia* : N. Ind. (Him.) Nepal, *Wallich* (*A. latum*, Wall. Cat. 209, not of Swartz); Sikkim and Bhotan, common. Assam—Khasi Dist. 1-5000', common. Bengal—Chittagong. Manipur W. 2000', *Clarke*. S. Ind. "Madras Presidency, in all the Western Forests up to 5000' (*Beddome* in Handbook). Burma, *Kurz*. Burma—Tenasserim? Ceylon. Malayan Penins. and Isles. Borneo—*Hose*. Tonkin *Balansa*. Japan. China—*Henry*. Polynesia. *Afr.* : Guinea Coast, Fernando Po, and Angola; Nyassa Land, *A. Whyte*; Mascareen and Seychelles Isles.

Trotter calls his *Kullu*, and Blanford his *Simla*, plant—*var. uda*, W. S. Atkinson, but I think these are merely young states of the larger plant got by Bliss at Simla, by the Mackinnons in the Dehra Dūn, and by myself near Naini Tal. Parish's immature Tenasserim specimen is doubtfully this, and *Kurz's* specimen from Burma has *sori* much shorter than usual.

8. *A. planicaule*, Wall.; Syn. Fil. 211. *A. laciniatum*, Don, *var. planicaule*, (sp.) Hook. C. R. 482. *A. laciniatum*, Don, *Bedd. H. B.* 154, in part.

PUNJAB : *Chamba*—McDonell (in List); *Simla Reg.*—Simla and vicinity 5600' and upwards, pretty common, 8 stations; Kunawar; Sirmur 1831.

N.-W. P. : *D. D. Dist.*; Jaunsar; Mussoorie and vicinity 4700'—6500', not uncommon; *T. Garh.*—below Laluri 3-4000', and Manma to Barahat, Duthie; *Sahira* 7000', Gamble; *Brit. Garh.*, below Kinoli 5000', Duthie; "*Garhwal*," T. T.; *Kumaun* 3-9000', common.

DISTRIB.—*Asia* : N. Ind. (Him.) Nepal, *Wallich*; Sikkim, Bhotan. Assam—Khasia Hills 2-6000', "very common." Bengal—Chutia-Nagpur, Parasnath Mt. 1858. Manipur 6000', *Watt*. S. Ind.—Madras Presidency, (*A. laciniatum*) "All the Western Mts. 3-8000' (*Beddome* in H. B.); Bombay Presidency—Mts. of Malabar (Clarke in Rev.), Ceylon. Japan. China—Ningpo Mts., *Faber* 1885 (so named by Mr. Baker; pinnae blunt.), Yunnan, *Delavay* 1883 (segments blunt), *Hance*. *Afr.* : Madagascar, *Buchanan*, *Baron*.

Mr. Clarke says the abundant Khasia form is the type of *A. laciniatum*, Hk. Sp. Fil. iii. t. 200 A., but he does not differentiate the localities for his *var. planicaule* (sp.) Hk. sp. Fil. iii. t. 200 B. *Beddome* writes of "typical *planicaule*" of S. India, and "typical *laciniatum*" of N. India; but I am not sure whether he means that both typical plants are to be found in both localities. Typical *A. laciniatum* (as Hooker understood it—see his figure in the *Species Filicum*) is unknown in N.-W. India, and I consider *A. planicaule* a good species. I do not think I have seen a type specimen of Clarke's *var. depauperata*, which he says comes principally from Kumaun. Plants that Blanford and Trotter have named *var. depauperata* are only small *planicaule*.



I was with Blanford in 1886, when we gathered some small plants of *planicaule* on an exposed dry cliff below Simla, and these he called *depauperata*; but I consider them quite typical *planicaule*, which grows largest on trees in moist forest. Clarke thinks that the existence of this variety (*depauperata*) destroys the value of the specific differences relied on by Hooker and Baker for distinguishing *A. planicaule* from *A. laciniatum*. I should say that the existence of *var. depauperata* requires proof; and Beddome, while saying that it is also found in South India, believes it to be only a starved form of *laciniatum*. I have not seen *A. laciniatum* growing, but judging by herbarium specimens it seems quite distinct from *A. planicaule*. Much depends upon descriptions and the describers.

9. **A. germanicum**, Weiss; Syn. Fil. 212; Bedd. Suppt. H. B. 31.

AFGHAN: Safed Koh 9000', Collett No 97, 1879, in Herb. Hort. Calc.

KASHMIR: *vide* Bedd. in Suppt. H. B.; *Kishenganga Valley*,—McDonell 1891.

PUNJAB: *Chamba*—Rāvi basin 6000', and Chenab basin 8500', Dr. J. S. Stewart, 824; "only once got at each station"; in Herb. Hort. Kew.

DISTRIB.—*Europe*: Great Britain—very rare; mountainous regions throughout W. and Centr. Europe: pretty general.

This is not mentioned by Baker and Clarke as an Indian species; but in 1888 I found the Chamba specimens in the Kew Herbarium. Dr. Stewart was Conservator of Forests in the Punjab, and the author of a book on Punjab Plants. Some six years ago Mr. McDonell found a scrap of *A. germanicum* among specimens of *A. ruta-muraria* he had gathered sometime previously in Kashmir, and sent it to me for confirmation of his discovery. Beddome's entry, in his Supplement of 1892, "Kashmir," without locality or name of collector, is vague, and might lead one to believe that the fern is common in that State.

10. **A. Ruta-muraria**, L.; Syn. Fil. 212; C. R. 482; Bedd. H. B. 156, and Suppt. 30.

AFGHAN: *Kuram Valley*—Shend Toi, Aitch. 1879, "common on rocks"; Lakman Khel Tangi, Duthie's collr. 1894.

KASHMIR and BALTISTAN: 5-8500', T. T., Lev., Clarke; Sind Valley 7-8000', Lev. 1875, *Baltistan*: Shingo Valley—Shivaram Nāla 10-11,000', Duthie; Kishenganga Valley—McDonell 1891; near Gurais 7-9000', Duthie 1892; Masjid Valley, 13-14,000', Duthie 1893; Sitalwān gorge 5000', Martand ruins and Sib Bāba Temple McLeod 1891 (in List).

N.-W. P.: *Kumaun*—Byāns, Kāli Valley, near Kangua 10-12,000', Duthie 1884; Kutti Yangti Valley 10-11,000', and Dhauli Valley 10,000', Duthie 1886.

NEPAL, W.:—*Kāli Valley*, near Kangua 11-12,000', Duthie 1884.

DISTRIB.—*Amer.*: U. S.; many parts. *Eur.*: Throughout—from Arctic Regions, to Spain and Portugal, Italy, Medit. Isles, Greece, Turkey. *Asia*: Turkish Armenia Ural Mts. to Caucasus; Turkestan 6000'; Thibet; Siberia. *Afr.*: Algiers, Cape Colony.



J. N. Fitch del.

A. C. Mukerjee lith.

# ASPLENIUM SAULII Hook.

1. Plant natural size.
2. A pinna  $\times 3$ .
3. Scales from base of stipes  $\times 20$ .
4. Portion of sori No. 3  $\times 50$ .
- 5 & 6. Scales from higher up on stipes  $\times 20$  and  $56$ .



Duthie's discoveries of four stations in Kumaun, and another—adjacent—in West Nepál, carry this fern much farther eastward in India than it was before known to grow. The gap between West Kashmir and Kumaun ought to be filled up. There is much variety in cutting in Duthie's specimens, as there is also in both cutting and size in the European plant, of which botanists have made several varieties. I have a plant I gathered on the inside wall of a ruined stove-house, exposed to the weather, in a garden near Edinburgh, on the old walls of which the species was abundant, which had 80 or 100 living fronds, and, as pressed, occupies a fan-shaped area 11 by 8 inches. This shows what the plant is capable of.

11. *A. Saulii*, Hook.; Syn. Fil. 216. *A. pekinense*, Hance, Syn. Fil. 213. (See Baker in Summary of New Ferns, Ann. Bot., Vol. V., No. XVIII), C. R. 483; Bedd. H. B. 156. *A. Saulii*, Hk., var. *pekinense*, Hance Bedd. Suppt. H. B. 31. Plate XVIII.

KASHMIR.—*Jhelam Valley*, 2-2500', Lev. 1875, 4000',—Trotter 1889; between Rámpur and Uri, "common; a few plants at Chakoti", MacLeod 1891; Chakot 3600', McDonell 1891.

PUNJAB: *Hazára*—Dhamtaur 4500', Leo Oertel 1890 *Chamba*—Rávi Valley, near Rúk 4000, McDonell 1882; *Kullu*, Trotter (in List).

DISTRIB.—*Asia*: Japan, *Oldham*. China—Szechuan, *Blakiston*, *Muingay*, *Robinson*; Peking Mts., *Hancock*; Ningpo Mts, *Faber*.

Mr. Baker in his Summary of New Ferns, 1891, unites *A. pekinense*, Hance, with *A. Saulii*, Hook., saying—"Further material shows that *A. Saulii*, Hook. in Blakiston's Yangtze, 303 (1862) is a larger, more compound, form of the same species (*A. pekinense*, Hance), and *A. Saulii* is the older name. It has lately been found by Levinge in the Himalaya (Chamba and Jhelam Valleys). I think Clarke is right as to Levinge's locality being in Kashmir, and the Jhelam does not flow through the Chamba State. In the Calcutta Herbarium, there are two sheets from Japan, named *A. sepulchrale*, Hook. = *A. pekinense*, Hance, *fide* Baker, of which the stipes are 6-8 in. long, and the fronds up to 10-11 in. l. by nearly 5 in. br,—almost tripinnate. Dr. Christ's var. *latius*, published in 1897, is quite covered by the original description of *A. pekinense*, and by specimens in the Kew Herbarium from various parts of China and Japan.

12. *A. Adiantum-nigrum*, L.; Syn. Fil. 214; C. R. 483; Bedd. H. B. 156.

AFGHAN. : Griffith, in Herb. Hort. Kew.

TRANS. IND. STATES : *Baraul* 4-7300', Harris; 4000' Gatacre.

KASHMIR : Badrawar 5400', and Poosiana, Clarke; "frequent 5-8000", (Cl. in Rev.); Chandrabhāga Valley 7000', Baden-Powell 1879; Lolab 6000', and Rembiāra Valley 6500', Trotter 1888; Lolab—Dardpura 5-7000' : "very common in the Lolab, on dry



clay bands" (embankments), MacLeod 1891; Martand Ruins 5500', McDonell 1891 Sind Valley 6-8000', T. T. (very large); Sind Valley—Kangan 6000', Gammie 1891: one sorus diplazoid; "Kashmir", W. Gollan, No. 9136 Herb. Saharanpur.

PUNJAB: *Hazara*—4—6500', Trotter 1886 and 1890; Murree 7000', Lev. 1875; Black Mt.—Panj Gali, Duthie 1888; Kagán and Siran Valleys 4—5000', Duthie's collr. 1896-97. *Chamba*—"Dalhousie and Chamba 4-6000', (Cl. in Rev.); Dalhousie, Colonel Dyas; McDonell (in List); "Chamba 5-6000'" J. Marten 1897, from Herb. Sahar.; *Kullu*, Edgew. in Herb. Hort. Calc.; *Simla Reg.*, Bates.

N.-W. P.: *T. Garh.*—Dr. Bacon; Herschel 1858. Ganges Valley—Gumgum Gád 8-9000', Duthie 1883; Lambatách 7000', Gamble 1891.

DISTRIB.—*Eur.*: United Kingdom; Norway and Denmark, through Holland, Belgium, Germany, France, Switzerland, Austria, Spain, Portugal, Mediterranean Region, Greece, Turkey.—*Asia*: Armenia, Syria, Arabia, Persia; Siberia; Java. *Afr.*: Azores, Canaries, Madeira (very common, ascending to 4000'), Cape Verde Isles. Kamerun Mts.; St. Helena; Algeria; Abyssinia; Natal; Cape Colony; Masc. Isles.

In the Kew Herbarium is a specimen marked "Mussooree, Dr. Bacon." This, and a specimen in the Saharanpur Herbarium, "Mussooree, Herschel," I have entered under *T. Garhwál*, as I do not think the plant grows in Mussoorie, or very near it. Mr. Gollan's fronds from Kashmir are the largest I have ever seen, and even larger fronds must have preceded them, judging by the old stipes left on the caudex.

13. *A. fontanum*, Bernh.; Syn. Fil. 216, excluding vars.; C. R. 484; Bedd. H. B. 158, excluding *var. exiguum*. Plate XIX.

AFGHAN.: *Kurum* Valley 11,000', Aitch. 1879; Peiwar Kotal 8000', Collett; Malána, Harsukh (Duthie's Collector) 1894.

TRANS-IND. STATES: *Baraul*—Mirga 8000', General Gatacre 1895.

KASHMIR: *Gilgit*: Tanner, Giles; *Baltistan* 10-11,000', Duthie 1892; elsewhere in numerous localities 45-12,000: Winterbottom 1847, Lev. 1875, Trotter, Gammie, Duthie, MacLeod, McDonell.

PUNJAB: *Hazára*—Black Mt., Duthie, 1888, Kagan Valley 5300', Trotter, 1889, 45-6090', Inayat (Duthie's Collr.) 1896-97. *Chamba*—10,000', Baden-Powell; over 8000', McDonell; *Simla Reg.*—Bisáhir: Jangi Forest 9500', Lace.

N. W. P.: *T. Garh.*—Ganges Valley, 8-9000', Duthie; *Kumaun*—Niti Valley 10,000, Mackinnons 1882; Byáns—Kali Valley 11,000', Kutti-Yangti Valley 10-11,000', Duthie 1884 and 1886.

W. NEPAL: Kutti Valley 10-11,000, J. R. Reid.

DISTRIB.—*Eur.*: England? Scandinavia? Belgium, France, Switzerland, Germany, Hungary, Italy, and Greece. *Asia*: Lycia, Ural Mts.

I have not gathered *A. fontanum*; but I possess numerous specimens collected by Trotter, Levinge, McDonell, Duthie, and MacLeod, in *Házára*, Kashmir, Chamba, Tehri Garhwál and Kumaun, and others from Afghanistan to West Nepal, and have seen many more collected by them, and, except as to size, I can say that the specimens are very uniform. Mature plants vary from 2½ to 12 inches in height, including root-stock. The longest I have seen are Major



J. N. Fitch del.

A. C. Chawdhary lith.

**ASPLENIUM FONTANUM** Hemph.

1. Portion of a large plant, natural size.
2. Frond of a large plant, natural size.
3. Portion of a frond,  $\times 3$ .
4. Caudex from another frond.
5. A small plant, natural size.



MacLeod's from Kashmir, at an altitude of 4500': one I have is 12 inches high; and I noted, when going over his collection, another plant which had 16 fronds covering, as dried, an area of 15 by 10 inches. Major MacLeod noted that the size of the frond is reduced at high elevations, *e.g.*, on Kuchil Peak, 12,000, alt., to only 3 inches. Two specimens from Kagan Valley, in Hazára, collected by Trotter, are 3 and 9 in. high, respectively; and from Chamba I have plants 3 in. and 7 in. There is never any resemblance or passage to the next species. The Indian specimens agree with the description of *A. fontanum* Bernh. in the *Syn. Fil.* in that they are all distinctly bipinnate: *A. exiguum* is never more than bipinnatifid. *A. fontanum* is always of a pale grass-green colour: almost yellowish sometimes: *A. exiguum* is dark green. And, corresponding to the cutting and venation, the position of the sori in the two plants is quite different. In *A. fontanum* the sori are all placed in the pinnules and segments, on the veinlets, without any relation to the costa of the pinna: in *A. exiguum* they are in a row on each side of and close to the costa. *A. fontanum*, so far as I know, never has fronds with the rhachis prolonged and rooting at the point; nor have I ever seen it proliferous on the pinnae. Both these features are characteristic of *A. exiguum*.

There is a wide hiatus in the record of distribution of *A. fontanum* between Chamba and the Ganges Valley in Tehri Garhwál (broken only by Mr. Lacey's gathering in Bisáhir), the intervening ground, except near Simla, not having much searched for ferns. Blanford does not record it from the Simla Region; nor is it in Mr. Bliss's collection. In Kumaon *A. fontanum* is got at from 10,000 to 12,000 feet above the sea, and thus, apparently, the farther south the fern goes the higher the minimum altitude to which it descends. It ought, therefore, to be got at high altitudes in the Punjab Hill States, eastward of Chamba, and in Tehri and British Garhwál. A great deal of the European material, called *A. Halleri*, Willd. (under *Aspidium*), which by some botanists is reduced to *A. fontanum*, is more like *A. exiguum* than like *A. fontanum*; but the fronds of *A. Halleri* are broader for their length, and the sori do not lie along the costa or secondary rhachis. Willd. said of *A. Halleri*—"ab. *A. fontano* abunde distincta species."

14. *A. exiguum*, Bedd., Ferns of Southern India, p. 49, tt. 146. *Asplenium fontanum*, Bernh., var. *β. exiguum*, Bedd. H. B. 158. *A. fontanum*, Bernh. C. R. 484. *A. Glenniei*, Baker, Syn. Fil. (2nd Ed., p. 488.) *Athyrium gracile*, Fournier, Plant. Mex., p. 102.

Though Colonel Beddome, in his Handbook of 1883, dropped this fern as a species, I am obliged to revive it, because I cannot clearly separate from it a comparatively common North-West Himalaya fern. *A. Glenniei*, Baker, which is



identical with the Himalayan plant, is a later name. For Colonel Beddome's description, which was written from specimens found in only one locality in the Nilgiri Mountains, in S. India, and which hardly covers the Himalayan plant, I substitute the following, which was written many years ago :—

*Plants* isolated, or united in tufts by the matted roots ; *Caud.* erect, short ; *St.*  $\frac{1}{4}$ — $2\frac{1}{2}$  in., rarely more than  $1\frac{1}{2}$  in., densely tufted, soft, castaneous, clothed at base with linear hair-pointed dark-coloured scales, upwards more or less so clothed, scales gradually changing upwards to soft hairs ; *fr.* linear-lanceolate, bipinnatifid, never nearly bipinnate, 2—9 in. l.,  $\frac{1}{2}$ — $1\frac{1}{4}$  in br. ; *rh.* flattened, winged, green in upper two-thirds, the castaneous colour of stipes extending farthest up the inferior side and sometimes in patches ; *pinn.* 20-25 jugate, oblong with an expanded base, or emarginate, sometimes leafy and then obliquely triangular and less cut, subpetiolate, blunt, costae inconspicuous, undulate laterally, lower pinnae more distant, shorter but scarcely narrower at base, sometimes trifoliate in shape ; *segm.* 3-6 jugate, having 1-6 teeth according to number of veinlets, lower margins concavely cut or scooped out, lowest anterior much cut away ; *colour* dark green ; *veins* immersed, obscure ; *scri* costal, one at the base of each segment, two or more in lowest anterior ; *fr.* often very attenuate upwards and rhachis prolonged and then rooting at tip ; *segm.* sometimes all truncate or emarginate at apex, and there proliferous.

PUNJAB : *Kullu*—7900', Trotter ; *Simla Reg.* 6900', not common ; Gamble, Collett, Cattell, Blarf., Hope, Trotter, Bliss.

N.-W. P. : *D. D. Dist.*—Jamsar, Barasti 7000', Gamble ; Mussoorie—6000' Edgew., Dr. Bacon, Jameson's Collr. 1850 ; 5500'—7300', Lev. 1872, Mackinnons 1878, Hope 1880-1895 (seen and studied yearly), plentiful in places on rocks in damp forest ; "*Garhwal*" Lev. 1872 ; *T. Garh.*—Ganges Valley 67000', Duthie ; *Kumaun*—Naini Tal, by the lake-side, Hope 1861 ; Harsila, Davidson 1875 ; below Naini Tal 56000' Trotter ; Dhaul Valley 10,000', Duthie 1885-86 ; MacLeod 1883. "N.-W. India", Falconer.

DISTRIB.—*N. Amer.* : "Mexico, *Mr. Consul Glennie*" ; Mexico—Rochers de Pedregal, *Bourgeau*, 1865-66, Chihuahua—Mapula Mts., *Pringle* 1866, Sonora, *Lloyd* 1890. United States—Arizona : Huachuca (?) Mts., *Lemmon* 1882.—*Asia* : N. Ind. (Him.) Sikkim (?) Wangtu, *Hook, fil. and Thoms.* 1847. S. Ind. : Nilgiri Mts., above Kalhatty waterfall, rare, *Beddome* 1864, Barliar 2500', *Gamble*. China—Moupin, *David* 1889 ; Mengte ; Yunnan, *W. Hancock* 1893 : "shady rocks, very local."

I have found no difficulty in separating this Himalayan plant from *A. fontanum*, Bernh. ; but it is not without hesitation that I come to the conclusion that it is the same as Beddome's Nilgiri plant. Beddome found his plant only in one station, and he then thought it nearly allied to *A. campyrorhachis*, Kze., which Baker unites with *A. lunulatum*, Sw.—Gamble has a dozen plants ticketed *A. crispum*, which he got near Barliar, on the Nilgiris, 2500' alt., all small and narrow, and with prolonged rhachises. In the *Synopsis Filicum*, under

*A. fontanum*, Bernh., *A. exiguum*, Bedd., from the Nilgiris, is mentioned as being a less divided form, with narrow fronds and ebeneous rhachis; and the authors go on to say that a similar plant had been gathered in Mexico by Mr. Glennie. But in the 2nd Ed. Mr. Baker set up what appears to be Beddome's plant as a new species—" *A. Glenniei*, Baker; Hab. Mexico, *Consul Glennie, Bourgeau*, 252—Very like some of the forms of *fontanum*." When at Kew in 1888 I pointed out to Mr. Baker and Col. Beddome that the specimens of *A. Glenniei* in the Royal Herbarium were merely a common N.-W. Himalayan fern, which I had been calling *A. exiguum*, Bedd. Prolongation of the rhachis into a naked tail often bearing a young plant, was a character given by Beddome in his description of the species, though this was not mentioned in the Handbook where he degraded it to the rank of a variety. This is a normal though not an invariable character of the Himalayan plant, as it is said to be also of *A. micropteron*, Baker, Syn. Fil. 488,—“rhachis much produced beyond lamina, rooting at the tip. Hab. San Luis, 7000', Pearce.” *A. micropteron*, however, differs materially in having a flattened and broadly winged rhachis, and also in cutting of pinnæ. I think that there is here (excluding *A. micropteron*) only one species, quite distinct, however, from *A. fontanum*, and that the N.-W. Himalaya is its headquarters; because the plant there grows to a much larger size than in either South India or Mexico—judging from the few specimens sent thence—and is very plentiful in certain parts of the range about Mussoorie. Mr. Baker's type specimen of *A. Glenniei* has not a prolonged and rooting rhachis; but in the British Museum there is one plant, among *A. fontanum*, ticketed—"U. S. Pacific Coast Flora, (new to U. S.) var. 'Conservatory,' Huackue (Huachuea?) Mts., Arizona, August 1882, Lemmon Herbarium, Oakland, California," which is exactly the Mussoorie fern, and it is prolific on the pinnæ throughout, and at the apex of the frond. And there are, in the same herbarium, two specimens from America, named *A. Glenniei*, Baker, which are exactly the Mussoorie plant. In the Calcutta Herbarium there are three specimens, named *A. Glenniei*, from America, one or two of which is the Mussoorie fern: the third is not.

The Mexican plant had been named *Athyrium gracile* by Fournier, in his Fil. Mex. 102, published in 1872, and Mr. Baker gives this as a synonym of his *A. Glenniei*. He was obliged to reject *gracile* as the specific name, because there was already *Asplenium gracile* of Feé, and also another plant so named by Pappé and Rawson. Fournier's plant is in the "*Herbier de la Commission Scientifique du Mexico, recueilli par M. Bourgeau 1865-66.*" Lemmon's plant collected in Arizona 1882, was identified by Baker as *A. Glenniei*, and was cited as *A. Glenniei*, Baker, by Eaton in the Bulletin of the Torrey Botanical

Club, 1883, p. 29; and the specimens collected by Pringle and Lloyd in Mexico in 1886 and 1894 also were so named. The entry in the Bulletin of the Torrey Club is as follows :—

"51. *Asplenium Glenniei*, Baker, described at p. 488 of the second edition of *Synopsis Filicum*, was scantily collected in the Huachuca Mts. by Prof. Lemmon. It is a small fern growing in little tufts like *A. montanum*; but the fronds are lanceolate, tapering both ways, 2-6 inches long, pinnate, with many pairs of oblong, toothed or pinnately lobed, deep-green pinnae. The sori are abundant, rather large, slightly curved outwards, and placed mostly very near the midrib of the pinnules. The fern comes near the old world *A. fontanum*, but it is not closely allied to any of our common species. I am obliged to Mr. Baker for the description."

If the Nilgiri (S. Ind.) plant be admitted to be the same as the American and Himalayan plants (Beddome added "Himalayas" as a habitat in his Handbook) then Beddome's name, being the older, must have priority over Baker's name *A. Glenniei*. *A. yunnanense*, Franchet in Bull. Bot. Soc. France, 1885, p. 28, which Mr. Baker, in Ann. Bot. 1892, placed as a variety of *A. fontanum*, Bernh., near *var. exiguum*, and of which Beddome, in his supplement of 1892, after describing it, says—"seems hardly to differ from typical *fontanum*," must, I think, also come under *A. exiguum*.

I have mentioned under *A. fontanum*, Bernh., some of the differences from it of *A. exiguum*; but indeed it would be more difficult to point out identical characters, or even resemblances between the two plants. *A. exiguum* varies considerably in width of frond and pinnae, and in cutting, but the variations are all away from the direction of *A. fontanum*. *A. exiguum* is abundant in many places within the municipal limits of Mussoorie, the hill sanitarium in the District of Dehra Dûn, where I have chiefly observed it, at altitudes of about 5500' to almost 7000 feet, on limestone rocks in the forest, generally with a north aspect. It grows in rock crevices, among moss, and spreads itself out like a star, the prolonged fronds bending backwards until they bury their tips in the moss seeking for cracks, or crevices, or earth, in which to root. The fronds last for two years, at least, living through the winter, in frost and snow, and through the succeeding dry, hot, weather in a shrivelled and apparently dead state until the rainy season comes in June or July, when they uncurl, and then frequently, if they have not already done so, produce young plants on their tips. This is followed by the springing up of fresh fronds from the same roots, generally not proliferous in that season, so far as I have seen. Judging from the numerous herbarium specimens I have seen, *A. fontanum* of the Himalaya has a more erect habit than *A. exiguum* has, and is never proliferous. Blanford says *A. exiguum* is rare in the neighbourhood of Simla. In Gamble's collection I found 3 sheets with 11 specimens—from Simla. On the five days' march from Simla to Bâgi,





J. N. Fitch del.

K. P. Daes lith

## ASPLENIUM VARIANS Hook et Grev

1. Large Plant: natural size.
2. Portion of a frond of same, enlarged 2 diams.
3. Small Plant: natural size.
4. Frond from the same, enlarged 2 diams.





eastward, on the great Thibet Road, in 1886, I saw only two or three specimens, at about 8000' altitude; but the fern may be more abundant at a lower level, off that road. In 1861 I saw one plant of *A. exiguum* at Naini Tal, by the side of the lake, but none anywhere else there, or on the way to Almora, 30 miles northward. There is no passage from this species to the next.

15. *A. varians*, Hook and Gr.; Syn. Fil. 216; C. R. 485; Bedd. H. B. 158. Plate XX.

AFGHAN.: *Kuram Valley*, Aitch. No. 469, 1899: "not common"; Peiwar Kotal 8000', Collett. 1879.

KASHMIR.: *Baltistan*—near Skardo, T. T. Punch Pass 9000' and near Pashana 7500', Winterbottom 1847; Chittapáni, Jhelam, and Liddar Valleys 4-8000', Trotter, Duthie, MacLeod.

PUNJAB: *Hazara*—from Black Mt. eastward to Murree, 7-9000', Duthie, Oertel, Trotter, Levinge, Hope, and Duthie's collector. *Chamba*—Chenáb and Rávi Valleys 6-7000' McDonell, J. Marten; *Kullu*, 5-9000', Trotter, Coventry; *Simla Reg.* 5-16,500', common, but nowhere abundant; Bisáhir, Brandis and Lace 7000'.

N.-W. P.: *D. D. Dist.*—Jaunsar, Lokandi 8000', Gamble; Mussoorie, Jacquem.; common on rocks in forest at 5500'—7000'; *T. Garh.* 5-13,000', Duthie, C. G. Rogers, Gamble; *Kumawn*, frequent

DISTRIB.—*Asia*: N. Ind. (Him.)—Sikkim 9000', *Hooker fil.*, Kurseong 3000', *Lev.*: Bhotán 6500', *Griffith.* Assam—Khasi and Jaintia Hills. S. Ind.: common on Nilgiris and mountains on west side, 3000' and upwards (*Bedd. H. B.*). Ceylon, 3000, and upwards, Japan. N. China, *Afr.*—Cape Colony, Caffraria, Natal.

Mr. Clarke says that this species and *A. fontanum*, Bernh., are very nearly allied: I demur. He also says that it is not difficult to separate the Himalayan examples from *A. lanceolatum*, Huds.; while Beddome says a form found at Kulhati in the Nilgiris quite runs into the European *lanceolatum*. In Gamble's collection is a sheet from Levinge, ticketed "*A. lanceolatum*, Huds., Kulhati, Nilgiris, 5000', 26-6-83", two plants on which are distinctly *A. varians*, and a detached frond very like *A. lanceolatum*, only the segments are more sharply toothed and the sori longer. I got a specimen in Murree (N.-W. Himalaya) a good deal like *A. lanceolatum*; but I should say that that species, besides being thicker in texture, is less distinctly bipinnate than is *A. varians*, is less sharply toothed, and has shorter sori. The stipes and rhachis also are stouter than those of *A. varians*; and other differences might be pointed out.

16. *A. tenuifolium*, Don.; Syn. Fil. 220; C. R. 485; Bedd. H. B. 159, F. S. I., t. 130.

N.-W. P.: *D. D. Dist.*—Sowárna Nála 4500', Mackinnons 1878; P. W. Mackinnon and Hope, 1881.

DISTRIB.—*Asia*: N. Ind. (Him.)—Nepál, *Wallich*; Sikkim and Bhotán, 5-9000, common. Assam—Khasia 4-5500', frequent. Burma—Moulmein, *Parish.* S. Ind.: higher ranges of the Nilgiris, Pulneys and Anamallays. Ceylon—Newera Elya,

In his list of the ferns of the Punjab, printed for private circulation, Mr. Trotter wrote :—"it has been collected at 'The Glen' near Simla by Dr. Watt, Dr. Cattell and myself," but Mr. Blanford did not admit this; and Mr. Trotter did not include *A. tenuifolium* in a manuscript list he subsequently sent me; so I suppose the plants were only *A. varians*, which is quite different in cutting. Beddome's figure accurately represents the Dehra Dún plant.

Sub-genus *ATHYRIUM*, *Roth.*

[*A. Hohenackerianum*, Kze., was given by Dr. Cattell in his "Handy Guide to the known Ferns of the Himalaya", Lahore, 1877, as having being found at the Chadwick Falls, Simla, and the entry was repeated in Mr. Trotter's privately printed list. Mr. Levinge, in a letter to Mr. Baker, preserved in the Kew Herbarium, said—"No. 54" (Trotter's pamphlet). "I do not believe that *A. Hohenackerianum*, Kze., was ever found in the Punjab. What Dr. Cattell got at the Chadwick Falls, Simla, (also alluded to by Blanford) was most likely *Aspl. drepanophyllum*, as I got the latter at Naini Tal in the N.-W. Himalaya". I agree with Mr. Levinge's belief, but not in the suggestion as to what Dr. Cattell's plant was, for there is no evidence to support it.]

17. *A. drepanophyllum*, Baker; Syn. Fil. 226; C. R. 487. *Athyrium falcatum*, Bedd.: Bedd. H. B. 164. *Athyrium drepanophyllum*, Baker: Bedd. Suppt. H. B. 32.

N.-W. P.: *D. D. Dist.*—Badrāj Mt. near Mussoorie, 5000', Mackinnons' Native Collector 1879.

*Kumaun*—below Naini Tal; in Herb. Gamble, coll. et com. Lev.: "2 or 3 miles above Rānībāgh road up to Naini Tal, 3-4000'—Levinge in letter to Hope, 25th February 1892.

DISTRIB.—*Asia*: N. Ind.: Assam—Khasia Hills, *Mann*; Bengal—Parasnāth Mt., 3-4000', *Clarke*, *Rev. A. Campbell*; Palāmow-Jaigir 2000', Gamble. Centr. Provs. (Ind.), Pachmarhi, *Blanford*, *Duthie*. "Centr. Ind.", *Col. R. Oakes*. Rājputāna—Mt. Abu, King 1860. Penins. Ind.—Mts. of Malabar, from Mahableshwar and Belgaum southward to the Anamallays: *Clarke* in 'Review'; Ganjam Dist.; Myhenda Hill 4500', and Anamallay Mts., dry grassy places, 5000', *Bedd.* in H. B.

18. *A. thelypteroides*, Michx.; Syn. Fil. 226; C. R. 488. *Athyrium thelypteroides*, Michx., Bedd. H. B. 164.

AFGHAN.: Shend Toi Valley 9-10,000, Aitch. 1880.

KASHMIR: Palgam 8500', Sind Valley 10,000, C. B. Clarke; 6-12,000, in various localities, Trotter, McDonell, Gammie, MacLeod, Duthie.

PANJAB: *Hazara*: Machpuri Mt. 8000, Trotter; Kagán Valley 14,400', Duthie's collr., 1896. *Chamba*—Kajiár 7000', Sara 11,000' C. B. Clarke; 7-8000', Baden-Powell, McDonell; *Kullu*—Jalori Pass 10,000', Trotter; *Simla Reg.*—Along ridge E. of Simla, from between Mahasu and Phagu to Hattu Mt., 8-10,000', Edgew., Bates, Collett, Blanf., Hope, Trotter, Bliss.

N.-W. P. : *T. Garh.*—8-13,000, Mackinnons and Duthie ; *B. Garh.* 9-10,000 Duthie ; *Kumaun* 7-13,000', Davidson, Duthie, MacLeod.

NEPAL, W. : 10-11,000', Duthie.

DISTRIB.—*N. Amer.* : Canada and U. S. A. *Asia* : N. Ind. (Him.) Sikkim and Bhotán. Japan, *Faurie*. China—Yünnan, *Henry* and *Delavay* ; N. Shensi. *Giraldi*. Amur Land.

I do not think the description in the *Synopsis Filicum* is altogether accurate, for the Himalaya plant at least ; because I cannot find any double (diplazoid) sori at the basis of the pinnæ. Nor should I say, looking at the Himalaya plant, that the species is "easily distinguished by its long sori in very regular rows." The involucre, especially near the main rhachis, are often very narrow in proportion to their length when in advance of or failing the development of the sporangia, and then they look long ; but when the fructification is well developed, the sori look broad and short. They are longish, however, in some American specimens. The veins are generally quite straight where the sori are ; but the inner or dehiscing side of the *involucre* is more or less curved, according to its width, so that its shape is more less segmental, sometimes nearly semi-circular : Colonel Beddome describes the sori as short, oblong. Towards the apex of the frond, and the apices of the upper pinnæ, the sori begin to vary in shape, some being curved across the vein, some didymochlænoïd, and some short-diplazoid—i. e., the returning half of the sorus and involucre is quite separated by the vein from the basal half. In this case the upper part of the involucre is hardly as long as the lower. I look upon these variations in the form of the sorus and involucre as of importance only as showing that there is no sound distinction, in shape of sorus at least, between *Euasplenium*, *Athyrium*, and *Diplazium*, unless the last sub-genus be restricted to the plants which have long, narrow, double sori, such, e. g., as *A. lanceum*, Thunb., and *A. buntamense*, Baker. *Asplenium* (*Dipl.*) *japonicum* is almost as much *Athyrium* as is *A. thelypteroides*, or *A. McDonelli*. I agree with Mr. Clarke that no varieties or even forms can be made out of this fern ; but Dr. Christ, in a paper written jointly by him and Dr. Baroni, published at Florence in 1897, on the Ferns and Fern-allies of the Shen Si Province of China, has set up a new species—*A. Giraldi*. A comparison of the specimen of this new species which Dr. Christ sent to Kew with *A. thelypteroides* shows no variation whatever from the latter-named species. *A. thelypteroides* is gregarious, and careful examination would probably show that the rhizome is slowly creeping, though thick, and the plants in a bed may be connected.

19. *A. McDonelli*, Bedd. in Journ. Bot., March 1889, p. 73, under *Athyrium*. *Athyrium McDonelli*, Bedd., H. B. Suppt. 34. Plate XXI.

KASHMIR : Panjab 5500', Baniar—Harpāt-Rai Nāla 5000', Kitarōji 6000', McDonell, August 1891 ; Lolāb Valley : Bāmāhāma and Aud'rbug 45-6000, MacLeod, September 1891.

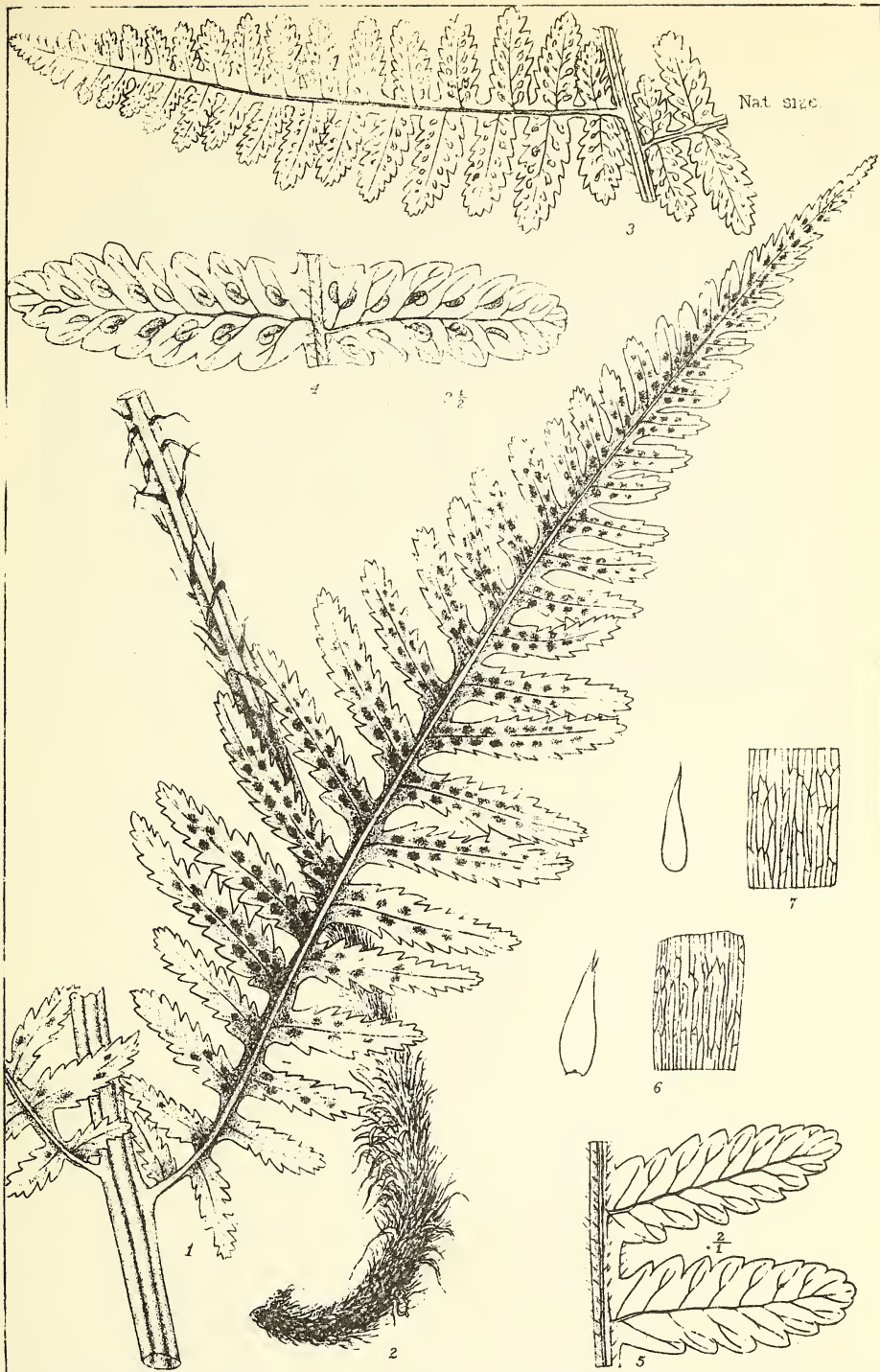


PANJAB : *Chamba*.—Ravi Valley, Chadbent Forest 6,000', McDonell, 1882.

DISTRIB.—*Asia* : Japan—Yezo Prov., *L'abbé Faurie*, 1889.

Colonel Beddome described this species in 1889 from two fronds, then shown to him by Mr. McDonell and myself. Mr. McDonell's frond had a bit of rhizome attached : mine had only an incomplete stipe. He (Mr. McDonell) had sent it to me several years before as *A. thelypteroides*, but I then noted that it was different and probably new. A third frond of the same gathering in Chamba I found, in 1896, in the Calcutta Herbarium. These were the only three fronds Mr. McDonell had up to that time got. After returning to India he was deputed to Kashmir, to have charge of the Forest Department of that State ; and in 1891 he found *A. McDonelli* plentiful in several localities there (W. and S. Kashmir, I think) ; and it seems probable that this fern has its headquarters in Kashmir, and that the Chamba station is an outlier. Mr. McDonell has explored Chamba thoroughly, and he is so sharp an observer that any other station there could hardly have escaped him. But, very curiously, the only specimen sent to Kew, as this fern, by its discoverer is, for me, *A. thelypteroides*. Mr. J. Marten, who has, more lately, been exploring in Chamba, does not seem to have found it.

The place of this species is clearly alongside of *A. thelypteroides*, and not where Colonel Beddome has placed it—after the *A. nigripes* group. The sterile fronds of young plants are hardly distinguishable in the herbarium, from similar fronds of *A. thelypteroides*, the cutting being sometimes almost identical. The main points of difference are :—(1) the rhizome, which is distinctly, though sometimes slowly, creeping in *A. McDonelli*, and erect or only procumbent in the other species (but see the suggestion at end of the last article) ; (2) the wider sinus between the segments or pinnules, which in *A. McDonelli* extends nearer to the rachis, and in well-developed specimens is square or often ob-cuneate at the base ; (3) in *A. thelypteroides*, the frond narrows gradually at the base ; in *A. McDonelli*, it is truncate, the lowest pair of pinnæ being hardly shorter than those above ; (4) the shape of the pinnæ, which in *A. thelypteroides* is invariable (though hardly so wide as 1 in., as the *Synopsis Filicum* has it), but in *A. McDonelli* varies with the size and age of the plant :—In one large specimen from MacLeod, I find the lowest three pairs to be pronouncedly lanceolate, and of the following dimensions :—lowest  $7\frac{1}{2}$  in. l.,  $2\frac{3}{8}$  in. br. ; next pair above— $8\frac{1}{2}$  in. l., 2 in. br. ; third pair— $8\frac{1}{2}$  in. l.,  $1\frac{7}{8}$  in. br.—the pinnules or segments being themselves cut down half-way to the costa ; (5) in *A. thelypteroides*, the pinnæ are patent : in *A. McDonelli* in large specimens acutely ascendant, the lowest less so. (6) the venation of the two species is quite different : in *A. thelypteroides* it is simple ; in *A. McDonelli* it is sub-pinnate, the vein forks, and one branch throws off one or even two



J. N. Fitch del.

K. P. Dass lith.

**ASPENIUM McDONELLI** Bedd.

1. Basal pinnae of a large frond, nat size.
2. Portion of Rhizome and Stipes from a smaller frond, nat size.
3. Portion of frond, from original type specimen nat size
4. Segments of pinna from do.  $\times 2\frac{1}{2}$
5. Segments of pinna from another plant.
6. Scale from base of stipes and enlargement of portion  $\times 2$ .
7. Scale from stipes. & enlargement.



veinlets after entering the lobe ; (7) and finally, the fructification is different : there is no rigid, straight-backed sorus in *A. McDonelli*, but, on the contrary, the utmost possible liberty and variety of shape. There is generally one sorus to each lobe, on the superior veinlet ; but in the lowest lobe there are sometimes two, and then the lower is attached to the lower side of the inferior veinlet, and the upper to the upper side of the anterior veinlet, so that they are placed back to back, but separated by the space between the two veinlets. All shapes of involucre may be found on the same pinnule : short-asplenioid, athyroid, pear-shaped—spreading on both sides of a veinlet without any apparent sinus or back at either end, and short-diplazoid—as described above under *A. thelypteroides*. Beddome, I think, at first intended to describe *A. McDonelli* as a *Diplazium*, and he says it has the habit of the Ceylonese *D. Schkuri*, and the Cuban *D. conchatum*. It has almost as much right to a place under *Diplazium* as *A. japonicum* has. The description requires revision by the light of the new material from Kashmir. *A. Henryi*, Baker, from China, is doubtfully distinct.

(To be continued.)



## THE FERNS OF NORTH-WESTERN INDIA.

Including AFGHANISTAN, the TRANS-INDUS PROTECTED STATES and KASHMIR arranged and named on the basis of Hooker and Baker's *Synopsis Filicum*, and other works, with New Species added.

BY C. W. HOPE.

(Continued from Volume XIII, page 671.)

### PART III.—THE GENERAL LIST—(continued).

20. *A. macrocarpum*, Blume; Syn. Fil. 227 and 489; C. R. 488. *Athyrium macrocarpum* Bl., Bedd. H. B. 165.

PUNJAB:—*Chamba*: Chatri Forest 7000', McDonell; 5-9000', J. Marten; *Simla Reg.*—"Syree" Edgew; Simla 55-7000', seven stations, Gamble, Bliss, Blanf., Trotter; Bhajji State, Bliss.

N.-W. P.: *D. D. Dist.*—Sowárna Nála 4-5000', Mackinnons; *Brit. Garh*—above Guinji 9000', Duthie (once); *Kumaun*—Binsar and Pindar 7-7500', Strachey; near Naini Tal, Hope 1861; Gori Valley 7-8000', Duthie 1884; Dhankuri Pass, Trotter 1891; Shama 8000', Gori Ganga Valley 8,000'—11,000', Rachpula Pass, 6750' MacLeod 1893.

DISTIB.—*Asia*: N Ind. (Him.)—Sikkim and Bhotan 2-9000', very common; Assam—Khassi Hills 2-6000', very common. S. Ind.—"very common on the W. Mts. above 3000'" (*Beddome*). Ceylon, Burma, Malay Penins, and Isles. N. China—Shantung *Dr. Maingay*. Japan.

Beddome and Clarke do not mention this species as being found to the westward of Garhwál. Some of the Simla and Kumaun specimens have been ticketed *var. Atkinsoni*, Clarke, and being small and sharply cut look distinct; but there are intermediate forms of all sizes and textures. MacLeod's specimens from the Rachpula Pass, Kumaun, are large, tripinnate, stiff, with very little lamina in the frond: possibly they are *A. foliosum*, Wall. (No. 32, *myra*), with sori larger than usual. Blanford says of the type, at Simla—"very rare, I have never met with it myself. But it was collected last year by a Simla resident a little below the Simla bazar, I believe, about 7000', or rather lower." And of *var. Atkinsoni* he says—"also very rare. I have found it only at the Chadwick Falls at 5820 ft., and not at all during the last two or three years." In 1886 Mr. Bliss gave me a specimen collected by himself in Simla: this habitat was new to Mr. Blanford. Mr. Bliss's diligence since then has proved that *A. macrocarpum* is to be found in several places all over Simla. Much of the N.-W. Indian material is very simply cut and membranous, and looks very different from the stiffer and more compound N.-E. Indian plant; but the sori are always much the same. Clarke's variety *1-pinnata*, from Assam, I should make a separate species.

21. *A. nigripes* Bl. MSS., *Aspidium nigripes* Bl. Enum., p. 162. *Aspl. nigripes* Mett., in Miquel's Annales, Vol. II., 240, and Vol. IV., 169; Syn. Fil. 227; Cl. Rev. 490. *Athyrium nigripes* Mett., Bedd. H. B. 166.

Blume's description, at p. 162 of his "Enumeratio," is as follows:—

"*A. fronde bipinnata membranacea glabriuscula, pinnis petiolatis oblongo-lanceolatis acutis, pinnulis subdecurentibus cuneato-oblongis obtusiusculis, infimis sub-petiolatis profunde pinnatifidis, superioribus inciso-serratis confluentibus, soris costulis approximatis, rachi glaberrima stipite trigono inferne paleaceo nigro.*"

"Crescit in paludibus inter montes Burangrang et Tankuwan—Prahū Javæ insulæ."

Mattenius, after giving the reference to Blume's "Enumeratio," says:—

"*Folia cum petiolo basi præsertim dense paleato quadripedalia; pinnæ inferiores 8 poli. longæ, pinnulæ infimæ 2-3 poll., pinnatifidæ, segmentis ovalibus serrato-pinnatifidis. Prostat lusus foliis tri nec quadri-pinnatis oblongioribus angustioribus, pinnularum segmentis ovalibus, mucronato-denticularis Allantodia paludosa (Zipp.)*"

The type specimen in the Kew Herbarium, which has Blume's ticket—"Herb. Lugd. Batav. *Asplenium nigripes*, Java Blume,"—is a small plant with erect black or dark-brown caudex, black roots, and bases of stipes clothed with small brown scales: it has 8 fronds, with stipes 6-7 in. long, as long as or longer than the fronds, straw-coloured, and naked except at base, bipinnate, pinnæ few, secondary rachises winged, lowest pinnæ as long as any but frond not deltoid, pinnæ not acuminate, pinnules narrowest at base, bluntly rounded, very setulose.

Some specimens from the Khasi Hills in Assam, 4-5000', from Clarke and Mann, agree with Blume's type specimen, and are also somewhat like my next species, especially in having *setæ* on the upper side of the costa; but they have much longer stipes than *A. tenellum* has, and the pinnæ are short and not much acuminate. Mr. Mann has named one of these *A. solenopteris* Kze., but except for having more lamina it is identical with another he has named *A. nigripes* Mett. and some high-level plants got in Sikkim, for which Mr. Clarke has (in MSS) suggested a variety name, *alpina*, may be the type plant. But the bulk of the material in herbaria from the north-east and south of India as well as from the north-west, ticketed *A. nigripes*, is quite different from Blume's plant. The type plant has not been got west of Nepál, that I know of. Most of the N.-W. India specimens I originally had in my *A. nigripes* wrapper I have removed: *A. Mackinnoni*, Hope; and only five remain, of which only one, from Kumaun, somewhat bears out Blume's name and description by

having very dark-coloured scales which extend some inches up the stipe; but the rhachis and costa are not setulose, and there are other material differences. These five N.-W. Indian specimens agree generally with the bulk of material in herbaria which is named *A. nigripes*, but which seems to me not to belong to Blume's plant; and I leave them here only to keep a place open for the species which has yet to be described and named. I cannot find a place for them under any other named species. They are—

1. PUNJAB: *Hazdra Dist.*—Changlagali 7500', Trotter No. 547, 1890.
2. KASHMIR: Gulmarg 75-8000', Trotter 1888.
3. & 4. PUNJAB: *Chamba*, McDonell? *Simla Region*—ridge east from Simla 8300', Hope 1886.
5. N.-W. P.: *Kumaun*—Gori Ganga Valley—Bugdiar 10500', MacLeod 1893.

22. *A. tenellum*, n. sp. *Allantodia tenella*, Wall. in Herb. 1821, under *Asplenium tenuifrons*, Wall. Cat. No. 206. Plate IV. (See Part II., p. 529.)

23. *A. tenuifrons*, Wall. Cat. 206. *A. tenuifrons*, Wall., Blanford in Journ. Asiat. Soc., Bengal, 1888. *A. Filix femina*, Bernh., Syn. Fil. 227. *A. Clarkei*, W. S. Atkinson, MS., Cl. Rev. 489. *A. nigripes*, Mett., var.  $\beta$  *Clarkei*, Bedd., Bedd. H. B. 166. *A. nigripes*, Mett., var. *tenuifrons*, Wall., Bedd. Suppt. H. B. 33. Plate XXII.

The following is Beddome's description of this fern, given in the Supplement to his Handbook. Except in two particulars—"very like the type", and—"not rooting at the apex"—it applies to the plants I call *A. tenuifrons*, which are the same as Wallich's type specimens in the Linnean Society's Herbarium:—

"Very like the type" (*A. nigripes*) "but fronds gradually attenuated towards the base, intermediate between the type and *Clarkei*, not nearly so narrow or elongated as the latter, and not rooting at the apex; the channelled secondary rhachis, the channelled midrib of the pinnæ" (pinnules?), "and sometimes the veins furnished with weak setæ on the upper surface, as in the type and in *Clarkei* (which distinguishes this species easily from some of the varieties of *Filix-femina*). Referred in the synopsis to *Filix-femina*, and by Clarke as a synonym of *Clarkei*. Considered as a species by some pteridologists."

PANJAB: *Chamba*.—Kalatop Forest 6000', McDonell; *Kullu* 6-7000', Trotter; *Simla Region*—Simla 7000', Hope 1871 and 1886, at the same station; Gamble 6000', 1878; 55-6000', Blanford 1886; Trotter 1887; Bliss 1890-92.

N. W. P.: *D. D. Dist.*—Jaunsar 5-8000, 1894; *T. Garh*, 7000', Mackinnons 1876; 7500', Gamble 1893; *Kumaun*, Davidson 1876; 4-7000', MacLeod 1893.





ASPLENIUM TENUIFRONS, Waltch.

A. C. Mukerjee lith.

- |   |  |
|---|--|
| 1. Portion of lower part of a frond, nat. size. | 5. Pinnule of No 4 $\times 4$ diams. upper side.   |
| 2. Apex of same frond, proliferous.             | 6. Under side of pinnule $\times 4$ diams.         |
| 3. Caudex of another plant, nat. size.          | 7. Portion of costa, enlarged 12 diams.            |
| 4. Pinna from middle of a frond. nat. size      | 8. Portion of secondary rhachis. $\times 2$ diams. |





DISTRIB.—Asia : N. Ind. (Him.) Nepál, Wallich ; Sikkim (*A. Clarkei*) T. T. ; 6-7000' W. S. Atkinson and C. B. Clarke ; Assam (*A. Clarkei*)—Naga Hills 5500', Clarke.

Both Beddome and Blanford say *A. tenuifrons* does not root at the apex, as *A. Clarkei* normally does ; but I think it probable that sometimes it does so root, for not unfrequently the fronds bear buds or bulbils near the apex, just as *A. Clarkei* does, which produce young plants ; and if late in the season, from-decay, such fronds should bend downwards the buds or plants would have a chance of taking root, or—the young plants may drop off and take root. I have a large frond collected by Mr. McDonell in Chumba, stipe 12 in., frond 27½ in. l., which has produced a young plant at two inches from its apex, one inch in length, stipe and frond together,—an aerial growth. Another plant, collected in Kullu by Mr. Trotter, with five fronds, has two buds on each of three fronds, and two of these have produced aerial plants about half an inch long. There are two minute buds on Gamble's No. 6311 from Simla ; and some very large fronds got in Tehri Garhwal by the Messrs. Mackinnons are proliferous, one having four buds. A frond from Kumaun (Colonel Davidson) has two buds, both of which have thrown out minute fronds. And, finally, Wallich's specimens of this plant, in the Herbarium of the Linnean Society have bulbils and young plants : one plant has five or six young plants on it. These are named—some *Asplenium tenuifrons*, Wall., and some—*Allantodia denticulata*, Wall. in Herb. 1823.

Mr. Clarke gives *Asplenium tenuifrons*, Wall., Cat. 206 (part of type sheet) as a synonym of *A. Clarkei* (and also *Allantodia denticulata* Wall.), but there are such differences in the shape of the fronds and of the pinnules that I hesitate to say that they are the same specifically. Both seem to like a moist soil. Clarke writes of the rhizome of Atkinson's plant—"stout, tufted, standing 2 inches out of wet sand, with a cluster of stipes at the top, radiating round and rooting in a circle, at a radius of about 2 feet from the central rhizome : the sub-terminal rooting bud seems always present in well-developed fronds ; rarely are there two rooting buds." At my Simla station *A. tenuifrons* grows in the bed of a torrent, and the caudex must often be under water in the rainy season. To make *A. Clarkei* a var. of *A. nigripes* seems to me, unreasonable ; but as it is not a North-West Indian fern, I am not here concerned in advocating its claims to be a species.

I have already indicated some of the principal features of *A. tenuifrons*. It is stiff and upstanding, though young plants approach *A. tenellum* in habit. If plants of the latter species should be found much longer than I have seen (one or two large ones, e. g., Mr. Duthie No. 3634 from Kumaun, the frond

of which, without the stipes, is  $21\frac{1}{2}$  in. l. by only 4 in. br.) and with a thick erect caudex, I might be disposed to unite the species, but—"as at present advised"—I must consider them distinct plants. Perhaps the most decided difference between both of these species on the one hand, and *A. nigripes* on the other, at least after the shape of the fronds, is the absence in the first-mentioned pair of the mass of long, narrow, light brown scales at foot of stipes, which is a prominent feature of *A. nigripes*. The scales in *A. tenuifrons* are dark brown, tapering to a hair point from a broad base; and though they clothe the stipes of young fronds before the fronds uncurl, they soon drop off, leaving the stipes quite glabrous, except for one or two inches at the base, which are sparingly clothed. A large specimen of *A. tenuifrons* in Mr. Bliss's collection is quite diplazoid; and I see a tendency to that form of *sorus* in other specimens also.

Mr. Blanford evidently formed a strong opinion as to the specific difference between *A. tenuifrons* and *A. nigripes*, and his remarks seem worth quoting in full; but most of what he called *A. nigripes*, in the Simla Region, was my *A. Mackinnoni* :—

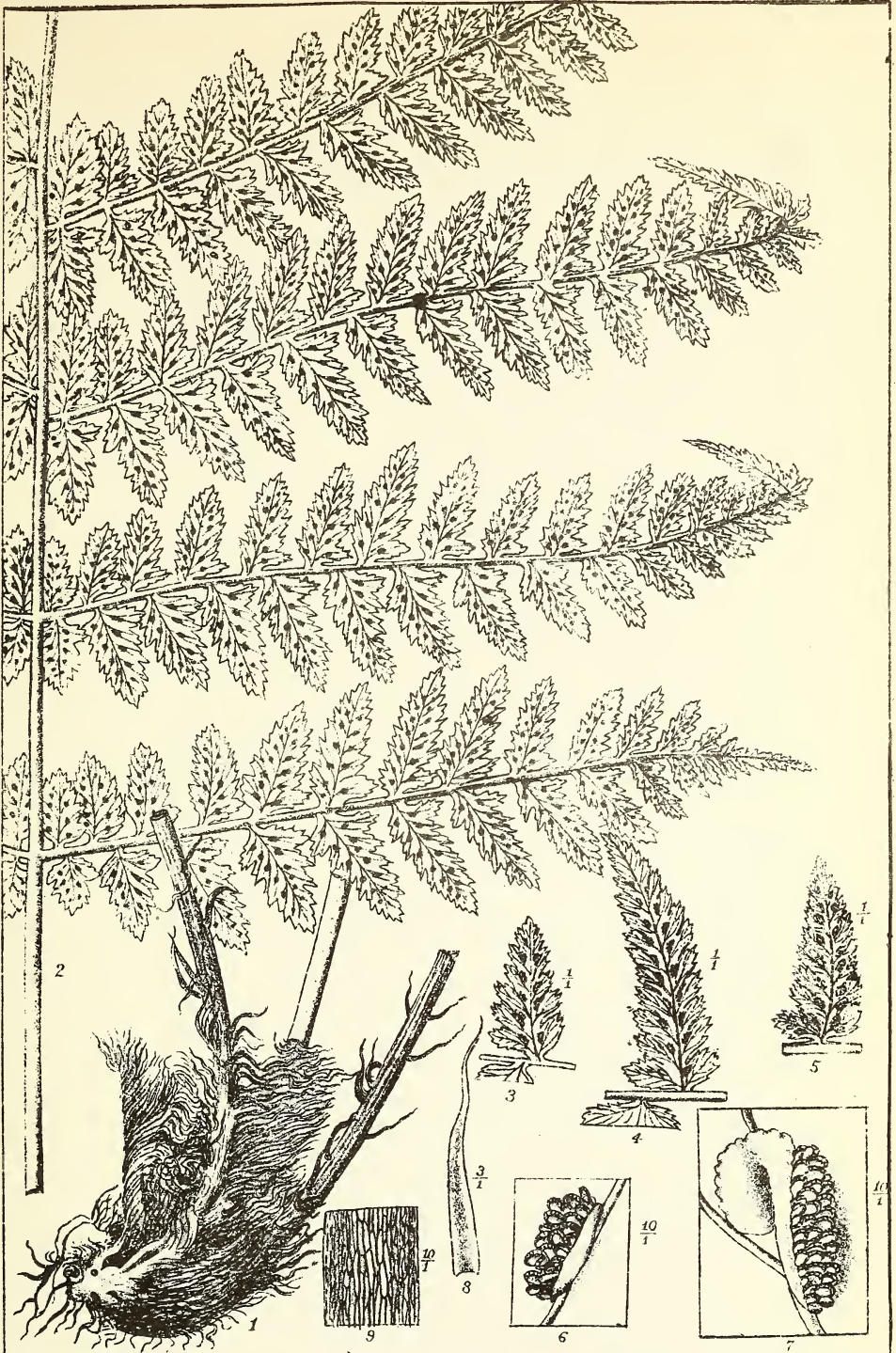
"Mr. Clarke regards this as merely a form of *A. nigripes*. In this view I cannot agree with him; differing as it does so greatly in habit and habitat, while neither exhibits a great range of variation. It is restricted to well shaded ravines, growing in the beds of streams at elevations below 7000 ft. The fronds, numbering 4 or 5 or more, form a circular tuft on the short erect rhizome. They vary in form from ovate-lanceolate to acute-lanceolate, and the width of my broadest specimen is less than half the length of the frond; in the narrowest it is less than one-fourth. The texture is thin and the upper surfaces of the partial rhachises and costæ bear long-glandular filaments. The colour of the frond in the fresh state is bright green, forming a beautiful contrast with the delicate pink tint ("purplish sometimes") of the rhachis and stipe. It is no doubt near *A. Clarkei*, and apparently grows in similar situations, but the fronds are broader and never root at the ends

What Mr. Blanford styles long glandular filaments, and Colonel Beddome—weak *setæ*, are called in the "*Synopsis Filicum*"—firm yellow spines or strigillæ. They seem to me to be quite soft, broadening at the base, and decurrent on the veins. Their function seems to me to be—to bother pteridologists.

24. *A. Mackinnoni* Hope, in Journ. Bot. March 1896, p. 124 :

"*Rh.* quasi-erect, clothed, as is also the base of the stipe, with bright castaneous filiform scales. *St.* tufted, straw-coloured or pale brown, glabrous except near the base or with a few scattered scales for some inches upwards, 8-20 in. long. *Fr.* sub-deltoid or almost rhomboidal (lowest pair of pinnæ slightly shorter than next pair above), 13-23 in. l. (average of sixteen measured— $18\frac{1}{2}$  in.) by 8-18 in. br. (average of twenty measured— $12\frac{3}{4}$  in.), bipinnate,





N. E. Brown delt.

A. N. Banerjee lith.

*ASPLENIUM MACKINNONI*, Hope, in Journ. Bot. March 1896.

1. Rhizome, natural size. 6. & 7. Fragments of pinnules, showing a straight  
& a curved sori with indusium,  $\times 10$ .  
2. Portion of frond, slightly reduced. 8. Scale from stipes,  $\times 3$ .  
3. to 5. Pinnules from different sized fronds, natural size. 9. Portion of Scale from stipes,  $\times 10$ .





glabrous. *Pinn.* about 20 pairs, rarely more or less, distant, sub-patent or ascending at an angle of less than  $45^{\circ}$ , lowest few pairs sometimes widest at one-third from main rhachis, others hardly diminished towards base, and with lowest pair of pinnules sometimes elongated, always acuminate,  $6-11\frac{1}{2}$  in. l. by  $1\frac{1}{2}-3\frac{3}{4}$  in. br. *Pinnls.* 20 or more pairs on longest pinnæ of large fronds, cut away at the base on the inferior side, and slightly auricled on the superior side,  $\frac{3}{8}-\frac{1}{2}$  in. br. at base, cut down two-thirds towards costa into 6-12 lobes with two or more teeth each, gradually narrowing and sometimes blunt at apex, decurrent on rhachis with sometimes a broadly winged base. *Texture* herbaceous. *Colour*, when dried, pale olive-green. *Ven.* of pinnules pinnate, and veinlets forked in the lobes, pinnate in the lowest. *Sori* mostly one on superior veinlet of each lobe, near to or at some distance from costa of pinnule, but more numerous in lowest lobes of large pinnules; *involucres* large, straight, athyroid, or hippocrepiform, and sometimes severed at the curve. Plate XXIII.

“*Hab. Asia*: Trans-Indus Protected States:—Baraul 8500, Harriss 1895; *Kashmir*, W.: 6-10,000', Trotter 1888, MacLeod 1891, McDonell 1892-93 Duthie (several stations) 1893. *Punjab*: *Chamba*—7-9000', Baden-Powell 1879, McDonell: *Simla Region*, 8200' and upwards, Blanford 1825, Hope 1886, Bliss 1890-91. *N.-W. Provinces*: Mussooree or neighbourhood, Herschel 1878; *Tehri Garhwâl State* 8000', P.W. and V. A.; Mackinnon 1879; 10,000'. Davidson 1875; 3-9000', Duthie 1883 7500, Gamble 1894; *Kumaun*: 9-10,000', Duthie 1884. *Bengal*:—Sikkim, Phulloom 11,500', Levinge 1880 (Gamble's No. 8538).

“A large broad-spreading fern, with a long stipe, and when dried reminding one of *Nephrodium marginatum* Wall., and me sometimes of *N. ramosum*, Hope. The scales at base of stipe are like those of *A. nigripes* Mett., but pale in colour, as is the frond. The sori do not lie in rows parallel to and near the costa, like those of *A. nigripes*, but are generally apart from it, curving outwards, and the involucres are generally much more curved. No doubt specimens of this fern are to be found in *herbaria* mixed with *A. nigripes*, but I think they ought to be separated. I erroneously entered it in the Saharanpur catalogue as *A. selenopteris*, Kze., but I must now separate them, and I name the species after the brothers Mackinnon of Mussooree, in whose collection I first saw it, and whose specimens are the largest I have seen, and also because they have largely added to the

number of species of ferns found westward of Nepál, and have found species which are absolutely new."

The above-quoted description was written in India for my paper on the "Ferns of the Chitral Relief Expedition," which was published in *The Journal of Botany* in March 1896. Since coming from India I have verified my surmise that specimens would be found in *herbaria* mixed with *A. nigripes*: those so found, and with other species also, in the Kew Herbarium, have now been separated. Earliest in date of collection is a sheet from Kashmir, *Winterbottom* No. 349, 5th June 1847; and next comes one with a ticket—"Ind. Or., Hook. fil and Thomson, Coll. T. T. 28th August 1849," which has been marked by Mr. Clarke *Aspl. nigripes* Mett. Sir W. J. Hooker had pencilled on the sheet—"V. A. decipiens, Mett. Aspl., p. 195, t. 6, figs. 9 and 10, quite accords." These figures are like bits of my fern. There is another specimen of Dr. Thomson's, dated 2nd June 1848, and one—"Kashmir, W. S. Atkinson, September 1874, com. C. B. C. No. 24177." In the British Museum Herbarium, among *A. umbrosum*, Sm., and *A. anstrale*, Brack., is another frond—"Kashmir—Winterbottom." In Kew I also found two specimens from the Simla Region, of my own collecting in 1886, named by me *A. nigripes*; and one from Hattu Mt. 9000', Collett 1885. In so naming this fern I then followed Blanford, who I believe followed precedent. It is, in greater part at least, his No. 42 (in List) *Asplenium (Athyrium) nigripes* Mett., of which he says—"The typical form of this fern is common in the partially shaded banks and hill sides, on the northern face of Kamalhari and Hatu, at elevations between 8000 and 9500 ft., but not nearer Simla. There are rarely more than 2 or 3 fronds on the rhizome, and they are firm in texture and, in general, nearly as broad as long." The position and shapes of the *sori* and involucres, together with the total absence of *setæ* on the secondary rachises and costæ, are quite sufficient to separate this fern from typical *A. nigripes*. Other records of this species, which have come to light since I returned to Great Britain are—The Kagán Valley, to the westward of Kashmir, 5000', Duthie's native collector 1896, and Chamba 7-8000' (3 sheets), J. Marten 1897, both in the Saharanpur collection.

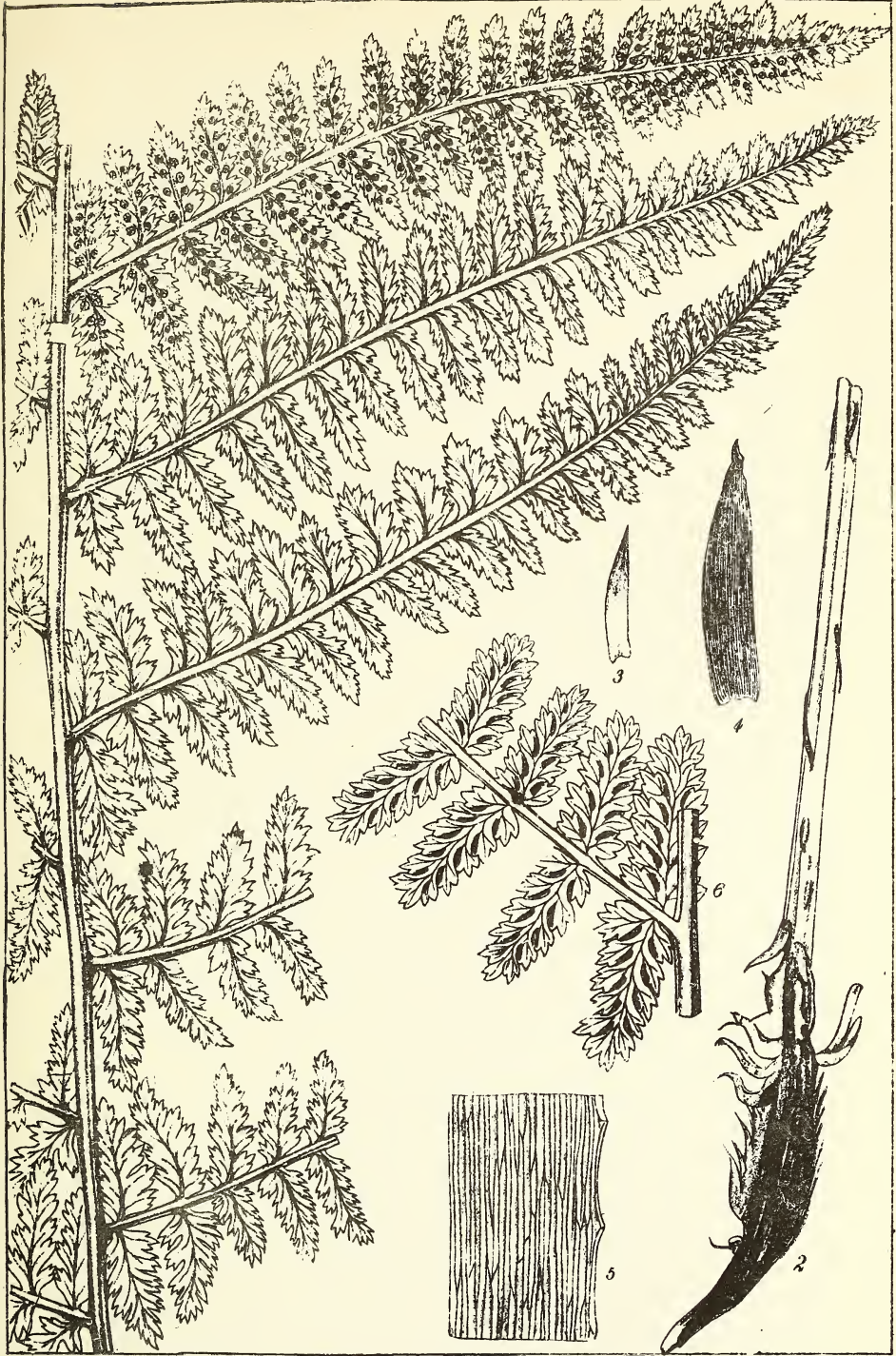
25. *A. Filix-femina* Bernh.; Syn. Fil. 192. *A. Filix-femina*, Bernh., C. R. 491, var. 1, *dentigera* only. *Athyrium Filix-femina* Bedd. H. B. 168, and Suppt. H. B. 35, var 1 *dentigera* Wall. only. *Polypodium dentigerum* Wall. Cat. 334.

*Forma typica.*

AFGHAN: 9-10,000', J. E. T. Aitchison, No. 830, 1880.

KASHMIR: Sarpat 9500' McDonell 1891; near Guraiz and near Gulmarg 8-9000', Duthie 1892.





J.N.Fitch del.

S.C.Mondul lith.

*ASPENIUM FILIX FEMINA* Bernh.  
forma *DENTIGERA* (sp) Wall.

1. Portion of a frond, from middle.
2. Rhizome and portion of Stipes, from same frond.
- 3 & 4. Scale from base stipes, natural size, & enlarged.
5. Portion of do. enlarged 30 diam.
6. Base of Pinna of another frond, enlarged 2 diam.





PUNJAB: *Chamba*.—Dalhousie 6000', Clarke No. 22540, 1874; Sára 14,000', Clarke No. 24111, 1874; Herb. Hort. Calcutta; near Langera 6000', and below Sabrundi 9500', McDonell 1882; *Simla Reg.* Hattu Mt. 9-10,000', T. Thomson 1847.

N.-W. P.: Kumaun—J. R. Reid 1886, in Herb. Saharanpur and Kew (Duthie's Nos. 6242 and 6285).

NEPAL W.: Opposite Budhi Village 10-11,000', and Nampa Gadh 12-13,000', Duthie 1886.

*Forma dentigera.*

(sp.) Wall., including probably *var.* 3, *attenuata*, Clarke. Plate XXIV.

AFGHAN.: 9-10,000', Aitch., No. 330, 1880, in Herb. Saharanpur: *var. attenuata*, on ticket.

TRANS. IND. STATES: Baraul 85-10,000', Harriss 1895.

KASHMIR: 6-12,000', T. T., Clarke, Trotter, MacLeod, Gammie, McDonell, Duthie: common.

PUNJAB. *Hazára*.—Trotter, in list of Punjab Ferns; Siran and Kagán Vys. 10,200', Chor. 10,000', and Nila—Duthie's Collector 1896-97. *Chamba*.—Rávi Valley, 8-10,000', McDonell: frequent?; 10,000', J. Marten; *Kullu* 6-8000', Coventry, *Simla Reg.*—north face of Kamalhari and Hattu Mts. 83 10,000', Blanford, Hope: Bliss.

N.-W. P.: *D. D. Dist.*—Jaunsar—Chachpur Peak 10,000', Gamble, and Herschel in Herb. Hort. Sahar; *T Garh.*—9-14,000', Duthie; *Kumaun*—Milam 11,500' S. and W. 1848; Rálam Vy. 11-13,000', and Byans—Napaleha 12,000', Duthie.

DISTRIB.—(*Forma typica*), *America*: Sitka and Labrador to Canada, British Columbia, and United States: Cuba, Caraccas, and Venezuela. *Europe*: Throughout the continent from Lapland, Russia and Scandinavia to Spain, Portugal, Italy, Greece, Crete, and the Caucasus. *Asia (forma dentigera)* Sikkim 10-13,000', rare: collected there by J. D. Hooker and C. B. Clarke. Kamschatka, and Japan. *Afr.*: Azores and Macaronesia; Algeria; Kamerun Mts; Abyssinia; Natal.

In the *Synopsis Filicum* it is not expressly stated that the European form of *A. Filix-femina* has been got in the Himalaya, and the following Indian names are given as synonyms, namely, *A. pectinatum*, Wall., *A. tenuifrons*, Wall., *A. gracile* Don., *A. stramineum*, J. Sm., *A. tenellum*, Wall., and *A. proliferum*, Moore. Agreeing, as I do, with Clarke and Beddome, that the two first of these plants do not belong to *A. Filix-femina*, and observing that in his Supplement of 1892 Beddome has put *A. stramineum* under *A. nigripes*, and *A. tenellum* under *A. pectinatum*, I find that there are left in the "Synopsis", as Indian representatives of *A. Filix-femina*, only *A. gracile* Don. and *A. proliferum*, Moore, of neither of which have I seen specimens in India, collected there. Until a few years ago I agreed with Mr. Clarke that exactly the typical form had not been found in India. But latterly, while I was still there, a comparison of the specimens from Kashmir, Chamba, Kumaun, and West Nepál, enumerated above, with my British specimens mostly collected by myself, compelled a change of opinion, and I decided to count typical *A. Filix-femina*

as an Indian fern, though a rare one. I have since found other Indian specimens of the typical plant at Kew. Most of the seven varieties which Clarke adopted or set up have already been upset or reduced to other species of *Athyrium*, and his var. 1, *dentigera* (*Polypodium dentigerum*, Wall. Cat. 334), I cannot distinctly separate from the type, the only real differences being in the shape of the pinnules, which are more equal-sided and less pointed than are those of the type, and in the cutting of the segments, which in *dentigerum* are always sharply toothed. I have seen the latter plant growing in the Simla Region, and at first I thought it was distinct; but I had no living specimens of the type with which to compare it. The type plant has not yet been found in the Simla Region by me or by any other collector in recent times; though there is a specimen of Dr. Thomson's in Kew marked as from Hattu Mountain. Without taking into account sports and cultural varieties, there is so much variation in individuals of *A. Filix-femina* found in Europe, that I could not expect European pteridologists to agree with me were I to separate *A. dentigerum*; but the fact remains that it is the common Himalayan plant, and that it does not vary, except in size. The smaller, and sometimes narrower-fronded, plants are Clarke's var. *attenuata* of the type.

26. *A. rupicola*, n. sp. PLATE V. (See Part II., p. 531.)

27. *A. Duthiei*, Bedd. in Journ. Bot. vol. XXVII., No. 315, Mar. 1889, p. 72; Baker in Ann. Bot. Vol. V., No. XVIII. Bedd. Suppt. H. B. 24, under *Athyrium*. Plate XXV.

I quote Colonel Reddome's description:—

"*Athyrium Duthiei* Bedd. Rhizome wide-creeping, black, nearly naked; stipe 3—4 in. long, furnished with a few ovate or lanceolate deciduous scales, glabrous, pinkish; fronds narrow, ovate-lanceolate, about 12 in. long by 3—4 in. broad; pinnæ lanceolate, alternate, about 20 on each side; lower ones gradually reduced, the central ones  $1\frac{1}{2}$ —2 in. long,  $\frac{1}{2}$ — $\frac{3}{4}$  in. broad, pinnatifid nearly or quite to the rachis into sharply-toothed obovate or lanceolate lobes about two lines broad; texture herbaceous; rachises glabrous, pinkish, furnished with a few deciduous large lanceolate scales; both surfaces glabrous; veinlets forked; sori asplenoid or hippocrepiform, 6—8 to each pinnule or lobe, *i. e.*, 3—4 on each side on the lower veinlets midway between the edge and the midrib.

"Collected by Dr. Duthie in the N.-W. Himalayas, No. 389, Gangotree" (Gangotri?), near the source of the Ganges, No. 392 under Srikanta 12-13,000'. No. 3667, at Rālam Glacier, Kumaun, 12-13,000'.



J. M. Fitch del.

A. C. Chowdhary lith.

# ASPLENIUM DUTHIEI Bedd.

1 Lower half of Frond, nat. size.

2 Rhizome, natural size.

3 Rhizome of another frond.

4. & 5. Scale from rhachis, nat. size,  
and enlarged 8 diam.

6. Portion of same scale, 30 to 1.

7. 8. & 9. Scale from Rhizome, and  
enlargements 6 & 20 diam.

10. Portion of Pinna, enlarged 3 diam.





"It is very similar in cutting to *Lastrea Brunoniana*. Dr. Duthie's three specimens had been sorted into that packet at Kew, where they were detected by Mr. Hope."

The entries in the Saharanpur Catalogue are :—

N.-W. P. : *T. Garh.*—Ganges Valley, Duthie No. 389, Aug. 1883; Lekhun Gád under Srikánta 12-13,000', Duthie No. 392, Aug. 1883; *Brit. Garh.*—"amongst bushes", near Kuari Pass 12-13,000', Duthie No. 5165, Sept. 1885; *Kumaun*—near Rá-lam Glacier 12-13,000, Duthie No. 3667, Aug. 1884 (Specimens from Tehri Garhwá, and Kumaun were contributed by Mr. Duthie to the Kew Herbarium).

DISTRIB. (as now known)—*Asia*: N. Ind. (Him.) Sikkim Ta-ne-doo Dr King's Collector, No. 4464, Aug 1877, 2 sheets—no rhizomes, and Goomthang 13,000' Dr King's Collector, July 1888, 2 sheets. Bhotán—Jongri, Dr King's Collector, Aug. 1887, 1 sheet, with rhizome.

I "detected" this *Athyrium* some years before I showed it to Colonel Beddome in the Kew Herbarium; but I had not then begun to write about Ferns. The creeping rhizome is a very characteristic feature of the plant. The frond diminishes in width from the middle very gradually to the tip: *N. Brunonianum* maintains its middle width of frond to within a few pinnæ of the apex, and is then suddenly rounded off. *A. Duthiei* is glabrous except for a few scattered scales on the main rhachis: *N. Brunonianum* is shaggy on stipe and main rhachis almost to the tip. It has been thought that the shagginess of the last-mentioned fern and its congener, *N. barbigerum*, Hook. is a natural protection against the cold of the high altitudes at which they grow; but *A. Duthiei* grows as high up, and yet is remarkably glabrous. If it always grows among bushes, as in one instance at least Mr. Duthie found it growing, the scaly clothing is not so necessary.

To the instances in which *A. Duthiei* has been collected I have now to add the following :—

*Kumaun*—R. Blinkworth 1827: 2 fronds, with incomplete stipes, and no rhizome: one with a Wallich's ticket "*dentigerum*, Wall." and another sheet 1 frond, marked by Bentham "*Polypodium dentigerum*, Wall., Kumaun, Wall. 1829." These are two more specimens on a sheet in the Kew Herbarium which was among *A. Filix-femina*, and has on it also an incomplete frond of *forma dentigera*, Wall., with Wallich's ticket.

(To be continued.)

## THE FERNS OF NORTH-WESTERN INDIA.

Including AFGHANISTON, the TRANS-INDUS PROTECTED STATES, and KASHMIR: arranged and named on the basis of Hooker and Baker's *Synopsis Filicum*, and other works, with New Species added.

By C. W. HOPE.

(Continued from page 127 of this Volume.)

### PART III.—THE GENERAL LIST.—(continued.)

28. *Asplenium schimperi*, A. Br.; Syn. Fil. p. 489; Blanford in Journ. Asiat. Soc., Bengal, Vol. LVII, Part II, No. iv, 1888. *A. filix-femina*, Bernh., var. 8 (c. C. B. Clarke's vars.), *Schimperi* (sp.), Mong.; Fée, Gen. Filic. (Polypod), p. 187, Clarke et Baker, in Journ. L. Soc., 8-12-1888. *Athyrium schimperi*, A. Br., Bedd. Suppt. H. B., 36.

PUNJAB: *Hazára*—Thandiána 8500', Trotter.

KASHMIR: Basaoli 6000', Clarke No. 31595, 26-9-'76; Rattan Pir 8000', Trotter.

PUNJAB: *Chamba*—Kajiár 7000', Clarke No. 24038, 1874; 7-8500', McDonell; 5-9000' J. Marten, 1897; *Simla Reg.*—T. T. Bates; Simla and along the ridge eastward 3-10,500', common.

N.-W. P.: *D. D. Dist.*—Jausár—Duthie's Collector; Mussooree and Landour 5-7000' and upwards, very abundant; *T. Garh.* 8-9000', Duthie, *Kumaun*—6-11,000', common.

DISTRIB.—*Asia*: N. Ind. (Him.) Sikkim—Yakla, *T. T.*; Dárjiling 7200', Levinge, *Gamble*. Centr. Ind.—Rájputána—Mt. Abu, *Duthie* No. 6794, 1887.

The Messrs. Mackinnon were, I believe, the first to hint that this fern was found in India, for in 1879, on getting the second edition of the "*Synopsis Filicum*", they thought that, from its widely creeping rhizome, the fern so common in Mussooree must be *A. schimperi* which was therein described, and they named their specimens accordingly. In Mussooree this fern grows in large beds. Some years later I mentioned the Mackinnons' opinion to Mr. Levinge, and I believe he and Mr. Blanford agreed it was correct, and worked it out when they retired from Government service and went home. Hence, probably, the entry of Simla as a habitat, on Blanford's authority, in Clarke and Baker's paper in Journ. L. Soc., 8-12-'88, though why Mr. Baker should have given in and withdrawn the species he admitted in the second edition, "*Synopsis Filicum*," I know not. These authors say, under *A. filix-femina*:—

"Adde var. 8. *Schimperi*, sp. Mong., Fée, Gen. Filic. (Polypod.), p. 187; rhizomate horizontali elongato.

"Simla, H. Blanford.

"Exempla, a H. Blanford communicata, cum Abyssiniciis omnino congruunt; H. Blanford autem exempla misit alia quorum rhizoma abbreviatum stipitibus contiguis."

From the last clause of the above, and also from what Blanford says in his "List" as to the fronds varying from lanceolate to deltoid lanceolate, I think it evident that these three authorities included, under *A. schimper*, *A. rupicola* Hope, though it has a very different root-stock. The rhizome, or *sarmentum*, of *A. schimper* is widely creeping and branching, and, where its growth is not impeded by circumstances, the fronds spring up quite apart; but *A. rupicola* grows in isolated plants: the caudex is thick and erect, or sometimes procumbent, and the stipes are always densely tufted.

The rhizome of *A. schimper* is densely clothed with bright-brown narrowly lanceolate-acuminate scales; those at the base of stipe few, and darker in colour. Blanford rightly says that the basal portion of the stipe is dark-coloured, though I should say purplish brown, rather than deep purple. Beddome rightly corrects Baker in saying that the frond is only bipinnate—tripinnatifid, or sometimes only bipinnatifid. I have both these forms grown on the same rhizome, and the cutting of their pinnules is very different. Beddome is incorrect, I think, in saying that the frond is "lanceolate, gradually reduced below": the shape may be called broadly lanceolate-acuminate, somewhat truncate at base: Blanford notices this. The rachises of the pinnæ are winged, with an actual interruption of the wing only in well developed fronds; and the pinnules are decurrent both ways on the rachis, so that the fern is only just bipinnate. Even in the largest Indian fronds the wing is sometimes unbroken, and it is continuous in the reduced basal pinnæ even when broken in those above. The basal pinnæ are apt to be sterile, or partly so, at their bases.

The specimens of the African and Indian plants in Kew do not exactly agree; and I have noted that the only specimen in the Calcutta Herbarium so named (before I picked out Indian ones in 1896), from T. Moore's Herbarium, ticketed Africa, is different from the Indian plant in cutting and that the pinnæ are opposite. That specimen has no rhizome. But the Indian plant may stand as *A. schimper* until the African plant is better known.

29. *A. pectinatum*, Wall. Cat. 231, as to type sheet only. *A. filix-femina*, Bernh. (an E. Indian form of), Syn. Fil. 228. *A. filix-femina*, var. 2, *pectinata* (sp.), Wall., C. R. 492. *Athyrium filix-femina*, var. 2, *pectinata*, Wall., Bedd. H. B. 169. *Athyrium pectinatum*, Wall., Bedd. Suppt. H. B. 36.

PUNJAB: *Chamba*—Ravi Valley, Sao Valley and elsewhere not specified, McDonell; *Kangra V. E.*—4500', Trotter; *Simla Reg.*—4500-6000', common, in and about Simla.

N.-W. P.: *D. D. Dist.*—In the Du—2500', Mussooree 4-6000': plentiful in several places; *T. Garh.* 4-5000', Duthie, Gamble; *Kumaun* 4-7000', frequent.

DISTRIB.—*Asia*: N. Ind. (Him.) Bhután 2-7000'; Bengal—Parasnath Mt. 4-4500' *T. T.*, C. B. Clarke, F. H. Ward in *Herb. Rev.* *A. Campbell*.



I have been disappointed that Mr. Baker has not admitted this plant to specific rank ; but possibly he has not seen the rhizome which is as widely creeping and branching as is that of *A. schimperi*—a character mainly founded on to distinguish the latter species from *A. filix-femina*. This radical difference in root-stocks in ferns is a distinctive character that seems to be quite unsurmountable. Possibly, accidental plants or cultural varieties of *A. filix-femina* may be found with cutting like that of *A. pectinatum*, but they cannot have a creeping *sarmentum*. Clarke's figure, Plate 68 of his "Review," shows the cutting of the frond well ; but, without the rhizome, which he does not even mention, it gives no idea of the appearance of the plant. Beddome's description in his Supplement should be referred to, but his *B. tenellum*, F. S. I., t. 154, which seems to show an erect caudex, cannot be this species. Sometimes, perhaps, fronds spring in tufts from the creeping rhizomes. In large specimens the lower pairs of pinnæ get very distant—four inches and more apart. The plant is very tender, succulent, and brittle in life. The sori are generally very minute, but the cutting of the plant is so fine that there is no room for large sori. The contrast between the habitats in Sikkim—on dry burning slopes to the South, according to Clarke, and, in the Simla Region, in damp ravines, according to Blanford, is very great. The plant, as I know it, grows longest in rich soil in the shade ; but I have seen it doing well in the open, and even on dry rocks, though stunted.

30. *A. oxyphyllum*, Hook ; Syn. Fil. 228 ; C. R. 493. *Athyrium oxyphyllum*, Bedd. H. B. 170.

N.-W. P.: *Garhwal*—*vide* Clarke in "Review" ; *Kumaun*—Naini Tal, Davidson 1875, in Herb., Hort. Sahar. ; between Dandihât and Karela 5-6000', Duthie No. 3170 1884 ; MacLeod 1893 (no locality stated).

DISTRIB.—*Asia* : N. Ind. (Him.) Nepâl to Bhutân : "very common from Nepâl eastwards" (*Clarke*) ; Assam—Khasia 3-6000', common, Kohima 5000', *Clarke*.

This seems to be one of the rarest ferns in North-Western India—only twice or thrice collected, so far as I know. MacLeod's specimens in my possession are very small, simply pinnate, with no involucre. Another small frond, from the same source, may be different : it is truly lanceolate, and the segments are completely covered with ripe sori, among which large reverted involucre are copiously present.

31. *A. fimbriatum*, Hook. ; Syn. Fil. 229 ; C. R. 494. *Athyrium fimbriatum*, Wall. (under Polypodium) Bedd. H. B. 172, and Suppt. H. B. 37, *var. squamatum*.

KASHMIR : Sarpat 10,000', McDonell and McLeod 1891 :—"Water-shed between Jhelum and Kishenganga Valleys, common at 10,000', never lower : on north slopes only" (MacLeod). *E. Kashmir*—*vide* Clarke in "Review."

PUNJAB : *Chamba*—Sâra 11,000', Clarke No. 24152, 1874, in Herb. Kew ; Ravi Valley 8000', McDonell, 10,000', J. Marten 1897 ; *Kullu*—8-10,000', Trotter ; *Mandi*

State—8-10,000', Trotter; *Simla Reg.* Jwal State, Chor Mt. 10,000', Collett; Ridge east of Simla 83-10,000', Collett, Hope, Bliss; Bisāhir—Kushung (or Kasong) Forest 9500', Lacey.

N.-W. P.: *D. D. Dist.*—Jaunsar: Deoban 9000', Herschel; *T. Garh.*, Nāg Tibā Mt. 9000', Mackinnons; Ganges Valley 9-12,000' and Jumna Valley 9-10,000', Duthie; *Brit. Garh.*—above Ramri 8-9000', Duthie; *Kumaun*—Guinji Pass 8000', Davidson; 5 stations 7-10,000', Duthie.

DISTRIB.—*Asia*: N. Ind. (Him.) Bhotān.

Beddome, in the Supplement to his Handbook, has rightly added to the description—"root-stock creeping, stipes solitary, distant," which character distinguishes this species from the next. So do the scales at base of stipe. In *A. fimbriatum*, as the "*Synopsis*" says, these are dark brown: in *A. foliosum* they are bright chestnut, and much more numerous.

I have gathered this fern only in the Simla Region, and at the time, following Blanford, I understood it to be Clarke's *A. Atkinsoni*, var. *Andersoni*; but I never could separate that fern from *A. fimbriatum*. Blanford has it under Clarke's variety.

On a sheet in the Saharanpur Herbarium, from British Garhwal, I find a note by Mr. Duthie—"used by *Pahāris* (Hill men) as a remedy for snake-bite". Doubtless: but would it not be as useful to use a snake as a remedy for the bite of a *Pahāri*?

32. *A. foliosum*, Wall. Cat. 339 (or 359); Bedd. Suppt. H. B. 37. "Root stock erect or suberect, stipes approximate; rhachis with a gland at the axis of the pinnae; stipes and rhachis often red; fronds up to 3 feet high; primary pinnae 5—8 inches long, generally about  $1\frac{1}{2}$  broad, but varying from  $\frac{3}{4}$  inch to 3 inches; lowest secondary pinnule on the superior side of the pinnae always more or less elongated and often double the size of the others; lowest superior lobe of the pinnule also elongated; sori strictly athyroid. Bedd. F.B. I., Pl. CCXCV, Wall. Cat. 339, first sheet in Linn. Herb. (the second being *Athyrium macrocarpum*). Clarke, pl. 62, fig. 1, (*sphaeropteroides*) a good figure of this plant, but scarcely showing the enlarged lowest secondary pinnule at the superior base of the pinnae which is most characteristic of this fern. This must, I think, rank as a species, being nearer to *macrocarpum* than to *fimbriatum*.

The above is Colonel Beddome's description.

PUNJAB: *Chamba*—Rāvi Valley—near Langera 6000', McDonell (in Herb. Gamble); *Kangra Vy. Dist.*—Dharmasāla 10,000', Clarke Nos. 23934 and 24361; *Simla Reg.* "above Simla," Bates; Ridge east of Simla 8000', *vide* Beddome; between Nagkanda and Bāghi 8500', Hope.

N.-W. P.: *Garh.*—Dr. J. L. Stewart; *T. Garh.* Nāg Tibā Mt. 9000', Mackinnons 1878-79; *Brit. Garh.*, 8-9000', Duthie No. 5152, 1885; *Kumaun*—Wallich in Herb. Kew; Kalimundi Pass 8000', S. and W.; Forest near Sosa 8-9000', Duthie 6255', 1886; Summit of Dhankuri Pass 10,500', Trotter No. 792, 1891; Mangalia Gor—ridge above Rānti, MacLeod 1893.

DISTRIB.—Asia : N. Ind. (Him.) Nepál—*Wallich* ; Sikkim—*Jerdon*.

As Beddome says, this fern is nearer to *A. macrocarpum* than to *A. fibratum*, i.e., as to cutting; but the different rhizome at once separates it from both; and the smaller, often very minute, sori show that it is not *macrocarpum*. I separated, as this species, some specimens in Gamble's Herbarium, from Sikkim and Bhotan, named *A. macrocarpum* and *A. fibratum*—the smaller sori being sometimes the chief guide; and some of these, and also McDonell's from Chamba, are hardly bipinnate. One Chamba plant, with fronds only 9—10" long, is tripinnatifid only near the base, and I was nearly describing it as a new species. Others, again, of the eastern specimens, are almost quadripinnate. The fern is, I think, never flaccid and membranous as some forms of *A. macrocarpum* are. The stipes and rhachises are wiry, though slender. The cutting is very defined and elegant: the sori copious from base to tip.

As to dimensions: my specimen from Tehri Garhwál, given me by the Messrs. Mackinnon, is a portion—the  $3\frac{1}{2}$  lowest pair of pinnæ, I think—of a very large frond; the width is about  $20\frac{1}{2}$  inches, and the second lowest pair of pinnæ 10 inches long (each) by  $4\frac{1}{2}$  inches broad. The frond must have been 6 feet, including stipe—twice the limit Beddome gives.

[*A. procerum*, Wall., Cat. 2203 (*A. umbrosum*, Sm., var. *procerum*, Syn. Fil. 489), said by Mr. Clarke and Colonel Beddome to be very common in the Himalaya, from Kumaun to Bhotán, has not been got west of Nepál, that I can see.]

#### Subgenus DIPLAZIUM, Swartz.

33. *A. longifolium*, Don; Syn. Fil. 234; C. R. 478.

*Diplazium longifolium*, Don; Bedd. H. B. 179.

PUNJAB: Chamba—McDonell, in list of Ferns identified at Kew; not seen; Simla Reg., Simla and neighbourhood 45-5500', seven or eight stations, Edgeworth, Bates, Fielding, Gamble, Blanford, Hope, Bliss.

N.-W. P. : *D. D. Dist.*—Mussooree, rare, Duthie 1877, Mackinnons 1878-79, Hope 1881; Kumaun—near Naini Tál, Hope 1861, Major Buckley.

DISTRIB.—Asia: N. Ind. (Him.) Nepál, *Wallich*; "very restricted in area and nowhere common" (*Clarke* in "Review"); Sikkim—in Herb. *Gamble*, com. *Levinge*. Manipur 6-7000', *Watt*.

This is undoubtedly a *Diplazium*, as *Diplaziums* go, and Mr. Clarke has, since the publication of his "Review", in which he placed it under *Euasplenium*, admitted it to be so, in the paper written jointly with Mr. Baker, Journ. Linn. Soc., 8th December 1888, in which it is said—"In exemplis, a H. Blanford communicatis, J. G. Baker paucos soros diplaziformes invenitit." Mr. Gamble has a specimen from Blandford with two or three diplazoid sori on it; and I have two or three fronds from Mr. Bliss on which double sori are



not infrequent : but the paired sori are never of equal length. Beddome's limitation of the sori to the lowest vein of each group does not hold good with regard to Simla and Mussooree specimens; from some of these there are numerous cases of short sori in or near the lobes on the other veinlets. And his figure does not represent these specimens when it shows the lowest superior auricled lobe bare of sori, for in some cases I see a double row of sori in the auricle, consisting of 2—4 pairs on either side of the main vein. The auricle (and sometimes the next lowest segment) has a tendency to be free and in one of Mr. Bliss's specimens it is quite so, and even petiolate.

34. *A. japonicum*, Thumb. ; Syn. Fil. 234 ; C. R. 498. *Diplazium japonicum*, Thumb., Bedd. H. B. 180.

KASHMIR : Coll. Mardan Ali, 1854, in Herb. Hort., Saharanpur; Panjab 53-5500', Kishenganga Vy. Kerán 5500', McDonell Nos. 33 and 34, 181.

PUNJAB : Chamba—Kalatop Forest 6000', McDonell 1881, Kangra Vy. Dist.—Edgew., in Herb. Hort. Kew.; *vide* Trotter in List; Simla Reg.—Simla 6000', Blauf., Bliss.

N.-W. P. : T. Garh.—Bhatauli 3-4500', Herschel, Mackinnons, Hope; Kumoun—Edgew., Lev., S. & W.; between Ramgarh and Peora, Hope 1861; Booreydar, Davidson 1875; Hawalbagh 4000', Trotter 1891.

DISTRIB.—Asia : N. Ind. Assam—Khasia 3000', abundant, Clarke; Bengal—Chittagong 200', common, Clarke. S. Ind.—Madras Presidency, on the W. Gháts; Nilgiris 7000', Pulney Hills 7000'; Tinnevely Hills; Jeypore Hills, west of Vizagapatam, 3-4000' (Beddome in H. B.). Manipur, Clarke. Burmah, Malaya, China. Japan. Polynesia. Australia. Queensland and Norfolk Island. Afr. : Bourbon.

I would add to the description of this fern that the fronds of the N.-W. India plant are dimorphous, *i.e.*, these are fertile fronds which have long stipes, and sterile ones which have short stipes. The long-stiped fronds are always fertile, and the short-stiped—never so. The sterile fronds are generally broader in proportion to their length than the fertile are, and the pinnæ also sometimes broader. A length of rhizome, with both sterile and fertile fronds on it, should always be gathered, or a correct idea of the species will not be got. I feel sure Beddome is wrong, as to the N.-W. Indian *A. japonicum* at least, in saying that the rhizome is "creeping or suberect." It is really always widely-creeping and branching, and sometimes very slender; but occasionally several fronds, sterile and fertile, are thrown up near each other in an apparent tuft. On some fronds few diplazoid sori are found; and I have sometimes seen hippocrepiform sori, *i.e.*, with involucre crossing the vein, unbroken and continuing down the other side of the vein for about half the length that they have before crossing. Other variations in the sori could be cited. I do not consider this species to be much more of a *Diplazium* than *A. thelypteroides* and *A. McDonelli* are.



Under the head of "Distribution" the Synopsis gives the Himalaya generally, and the other authorities give Nepál as the Eastern limit ; but the same, comparatively glabrous, plant is got in Sikkin, for in Mr. Gamble's collection I find three sheets from Goke and Singtam (Dárjiling) and from the Jeylep Road ; and there is also a sheet from Manipur—Nonjaibang 750', *Clarke* No. 42338, 1885. I have a specimen of Clarke's from West Manipur 1000', 1885. *D. lasiopter*'s, Kunze, which Clarke, and (whom following) Beddome, unite with *A. japonicum*, is rougher and coarser looking, and *D. thwaitesii*, Br., and *A. decussatum*, Wall. (*D. polyrhizon*, Baker), though also so united by the same authorities, seem to have their differences. Beddome's figure, F. B. T. 292 of the latter, shows an isolated plant with an erect caudex, but he says he has found typical *decussatum* with the rhizome creeping, though it is generally erect : this shows that he has confounded two distinct species, for this statement involves a physical impossibility. A fern with a slow growing, erect caudex may be fixed in a recumbent position and then grow horizontally ; but that is quite a different case from that of a plant with a thin quick growing rhizome sarmentum which creeps and branches underground, and throws up fronds at intervals, forming a bed. But as no one has attributed any of these three similar plants to N.-W. India, I need not further deal with them.

35. **A. torrentium**, C. B. Clarke in "Rev." 500, f. 64 (fig. 2 excluded) ; Journ. Linn. Soc., 1888.

PUNJAB: *Simla Reg.*—Near Simla "either Chadwick Falls at 5800' or Samáli Nála at 4500', Blanford.

DISTRIB.—*Asia* : N. Ind. (Him.)—Sikkin, "on margins of torrents, rare," *Clarke*.

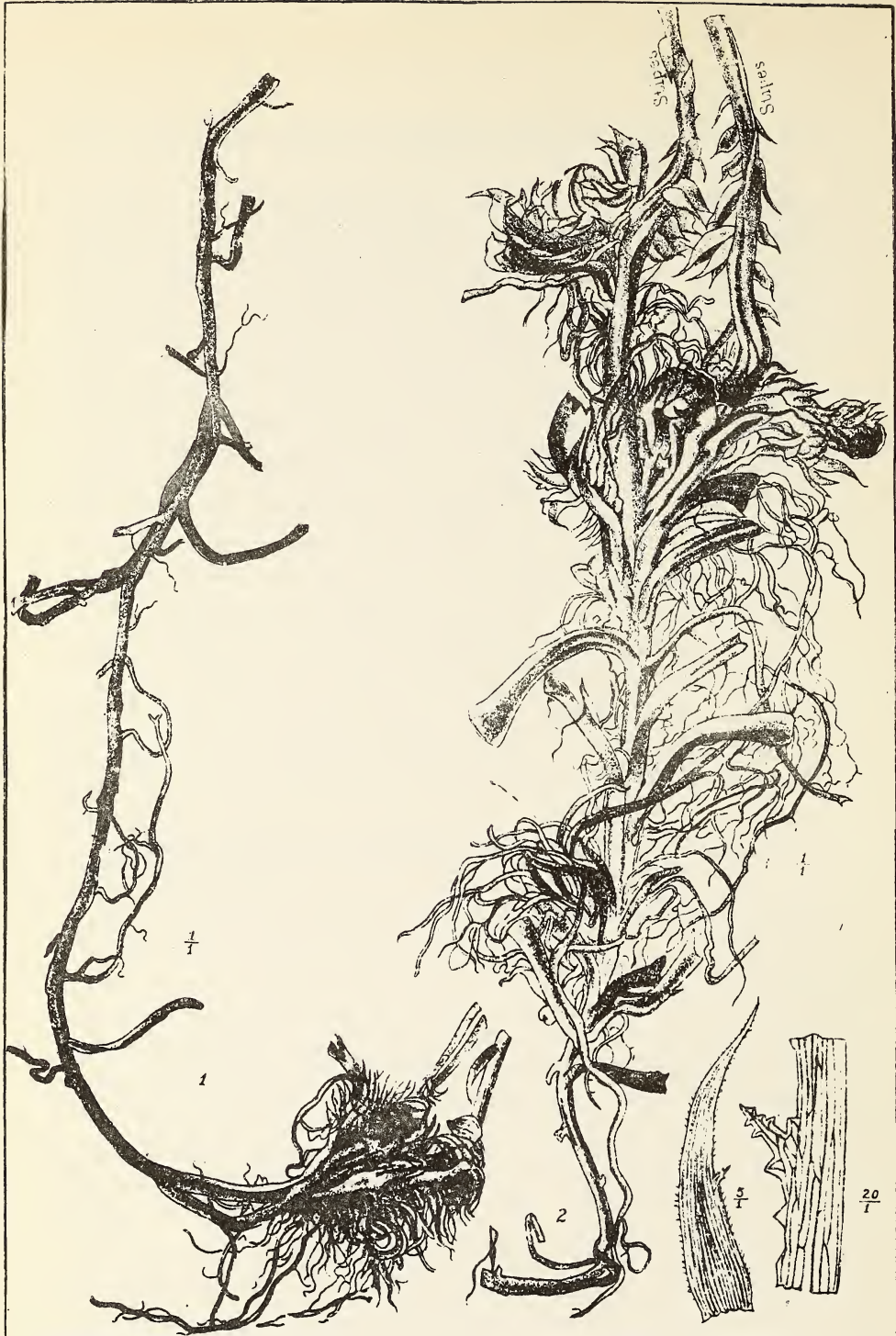
Blanford, who figures a small frond of this (Pl. XVI., Journ. Asiat. Soc., Bengal, 1888), says he gives this species on Mr. Clarke's authority, but he had regarded it as merely a simple form of *A. polypodioides*, Mett. Clarke and Baker have given Simla, Alt. 6000 ped., H. Blanford, as an additional habitat, in their joint paper referred to above. The specimen is in Kew. Beddome seems to consider this plant as merely a variety or form of *A. polypodioides*.

36. **A. polypodioides** Mett. ; Syn. Fil. 238 ; Cl. Rev. 501. *Diplazium polypodioides*, Mett., Bedd. H. B. 184.

KASHMIR : Clarke ; Trotter in "List" ; McDonell in Herb., Gamble.

PUNJAB : *Hazara*—The Gullies 7000', Murree 7000', Trotter. *Chamba*—3-7000', Clarke ; McDonell ; Trotter 5000' ; 6-10,000', J. Marten 1897 ; *Kullu*—Trotter, Coventry ; *Mandi State*—7-8000', Trotter ; *Simla Reg.*—4-6000', common about Simla ; Pábar Vy. Edgew. ; Kunáwar—Dr. A. Grant.





J. N. Fitch del.

# ASPEENIUM SQU

- 1 & 2. Rhizomes of Kashmir specimens, natural size.
3. Rhizome and base of stipes of Eastern Punjab specimen.
4. Scale from base of stipes, enlarged 5 diam, and portion of specimen  $\times 20$  diam.
5. Portion from middle of E Punjab Specimen, natural size





AMICERUM Mett.

Lith by E. P. Dass.

1. Rhizome and base of stipes of Kumaun specimen, natural size.
2. Pinna from middle of frond of Kumaun specimen, natural size.
3. Pinna from Kashmir specimen, natural size.
4. Pinnule of small frond from Kashmir.





N.-W. P.: *D. D. Dist.*—Jaunsar 6-7500', Gammie, Gamble; Mussooree 55-6500' common; *T. Garh.*—4500'-12,600', Duthie, Gamble; *Brit. Garh.*—7-8000', Duthie; *Kumaun*—4-8000', common.

DISTRIB.—*Asia*: N. Ind. (Him.)—Nepál!; Sikkim and Bhotán, 2000' and upward, very common; Assam—Khasia 2-6000', very common; Kohima 5500', *Clarke*. S. Ind.—W. Forests up to 6000'. Ceylon. Malaya. Australia.

This fern varies much in size and cutting, and also in length of sori, but I think all the N.-W. Indian plants are the same. On seeing them growing in many places, in the Simla Region, Mussooree, and Kumaun, it never struck me that there was any difference. Gamble has named his "No. 25097, Jaunsar 7000'," *Diplazium latifolium*; but the venation is quite different in the two species, and attention to that distinction should prevent any confusion. In all the specimens of *A. latifolium* I have seen the veinlets are simple, though Beddome says simple or forked; the veinlets of *A. polypodioides* are always forked. The venation of Gamble's plant from Jaunsar is that of *A. polypodioides*. Specimens from Simla, marked var. 3, *sublatifolia*, Clarke, also have the venation of the type. This being so, I cannot understand why Clarke says—"This series of plants distinctly approaches *A. latifolium*"; nor why Beddome says—"His (Clarke's) variety *sublatifolia* runs into *latifolia*, and rather belongs to that species, if the two are really distinct, which is very doubtful."

The involucre of *A. polypodioides* are very fugacious, and I believe they are sometimes absent in an early stage of growth. Both Leringe and Trotter were tempted by this to think of *Gymnogramme*. The Mackinnons have shown me plants in cultivation which were quite exinvolucrate. The young fronds are edible. Trotter says the Punjab Hill people eat them like spinach, and call them *Kasmor*. About Mussooree, also, the fronds are eaten, and called *lingra*.

37. *A. squamigerum*, Mett., in Miguel's *Annales*, Vol. II. 239; Syn. Fil. 237. Plate XXVI.

KASHMIR: Kishenganga Valley, Keran Nála 8000', McDonell, 3rd September 1891; Kajliban, in moist forest, Duthie, No. 12630, 1892; below Gurais 8-9000', Duthie No. 14100, 29th September 1893; Kachal 8000', and Donari Nála 7000', McDonell 1894.

PUNJAB: Chamba State 8000', J. Marten 1897; *Simla Reg*—Giri Valley, in Raiengarh Forests 6500', Gamble, July 1898.

N.-W. P.: *Kumaun*—near Kathi 7800', S. & W. 1848; Dipl. No. 4 on ticket; Pindar Gorge—Khati 7000', Trotter, 9th September 1891.

DISTRIB.—*Asia*: China—Patung District, *Henry*; Szechwan (Omei) *Faber*. Japan Siebold, Oldham, Robinson, Bissett, Maries, Hancock, Dickins, Faurie.

I noted this fern as being new to me in Mr. Trotter's collection made in Kumaun in 1891, and brought by him then to Mussooree, and soon afterwards I received a specimen from Kashmir, collected by Mr. McDonell, as it turned out, six days before Mr. Trotter got his specimen, and, though they somewhat differed, I referred them to the same species. I described and named the plant as *A. Trotteri*, under the impression that Mr. Trotter was the first to gather it: there was already an *A. McDonelli*, Bedd., and Mr. Trotter well deserved the compliment. I sent the description to a London botanical periodical for publication, but it never appeared. As will be seen, however, from the entry above, under the habitat "Kumaun", both Trotter and McDonell must yield place as discoverers to Strachey and Winterbottom, who found the fern in 1848, at what is probably almost exactly Trotter's station, there being only a difference in the spelling of the vernacular name and an estimated difference of only 800 feet in the altitude. As Mr. Trotter was always very particular about the spelling of the names of localities, I think it probable that Strachey and Winterbottom's locality was Khāti, and not Káthi. Their specimen, which is in the Herbarium of the Royal Botanic Garden of Calcutta, has no rhizome; but otherwise it agrees exactly with Trotter's. It is distinctly a *Diplozium*, with curved sori long for their breadth; and it differs also in cutting from *Athyrium crenatum*, Rupr., the habitats recorded for which are—Scandinavia, by way of Siberia, to Japan. Mr. McDonell collected some more specimens of his plant in Kashmir in 1894, and sent one, with other ferns, to Colonel Beddome who reduced it to *A. crenatum*, Rupr., saying that it exactly agreed with Japan specimens. Colonel Beddome had not then seen the Kumaun plant. But Mr. McDonell's Kashmir specimens, though they are smaller, more compound in cutting, and more delicate, agree in rhizome and sori with the Japan specimens of *A. equamigerum*, with which species I became acquainted on returning to England in 1896. Mr. McDonell wrote in 1895—"As to *Trotteri*, it seemed to me that the plant I got in September 1891 is not quite the same as that I sent last year; the former was growing in a cave, the latter is common on hill sides, growing with *Filix-mas*, under cover of trees, in shady places."

Mr. Marten's specimens from Chamba, and Mr. Gamble's from the Raiengarh Forests, are large, and intermediate in cutting between the Kumaun and the Kashmir plants. Mr. Duthie's Kashmir specimens, No. 12630, are more like *A. crenatum*, though some of them differ considerably. His No. 14100 quite matches a specimen from Japan, Yezo—*Forêts de Yubari*, Faurie No. 8111, 3rd July 1892; but the rhizomes are not complete enough.

Pending the collection of further material in the Himalaya, I have given up the attempt to differentiate the three forms, and I give the following description which is intended to cover all the Indian specimens :—

“*Rhizome* more or less slender, widely creeping and branching, black, sending up fronds 1 inch, more or less, apart, stipes sometimes in clusters. *Stipes* up to 1 foot or more long, slender but wiry, their bases clothed with very dark brown large lanceolate-acuminate scales, extending a short way up the stipes and then becoming scarce. *Rhachis* with a few scattered scales the same as those at the base of the stipes, but smaller, and with tufts of linear scales in the axils. *Frond* subdeltoid, bipinnate. *Pinnæ* markedly petiolate, about 13 pairs besides the acuminate pinnatifid apex—lower 5—6 pairs almost opposite, lanceolate-acuminate, lowest  $1\frac{1}{2}$ —2 in. br., 2 inches apart, all distant. *Pinnules* 10—11 pairs besides the crenate apex, distant, patent, deeply cut into rectangular rounded segments towards the base, and crenated towards the acuminate apex, margins scarcely toothed. *Veins*—3—5 pairs in a segment, curved and often forked. *Sori*  $\frac{1}{6}$ — $\frac{3}{8}$  inches long, very narrow, curved like the veins, up to five in number in lower segments and in others one on each lowest anterior veinlet, pointing to the sinus between the segments, and forming a row curving outwards on each side of the costa : some of the lowest diplazoid, or semidiplazoid. *Involucres* persistent, and sometimes much broader than the sorus.”

Mettenius's description was written from a fragment collected in Japan by Siebold : it began—“*Rhizoma?*”, and ended—“*indusium membranaceum tenerum integerrimum.*”

Mr. Baker's description in the *Synopsis* is :—

“238 A. (*Dipl.*) *squamigerum*, Mett.; st. 6 ins. or more long, straw-coloured, slender, with small scattered, nearly black lanceolate scales throughout; fr. 12—15 ins. long by nearly as broad, deltoid, lower pinnæ 6—9 ins. long, 2—2½ in. broad pinnate except at the apex; pinnules 1½ ins. long,  $\frac{3}{4}$  ins. broad, the point blunt, the edge broadly lobed, the lower lobes  $\frac{1}{4}$  in. broad entire; texture herbaceous; rachis slender, stramineous, chaffy below; veins subflabellate, the lower veinlets of the lobes with one or two lateral curved forks on each side; sori linear, curved, falling far short of the edge, the lowest 2 lin. long. Mett. Fil. Ind. 2, p. 239.”

“Hab.—Japan, Oldham, Siebold, Robinson.”

*Asplenium* (Athy.) *crenatum* Rupr. resembles A. (*Dipl.*) *squamigerum* in having a black creeping rhizome, and broad ovate-lanceolate dark-coloured scales at the base of the stipes; and also in the crenate pinnules. The rhizome of some specimens of the Kashmir plant is almost as slender as that of A. *crenatum*: that of others, and of the Japan



and Kumaun plants, seems to be stouter, and sometimes to throw up fronds in tufts ; but there are few examples with rhizomes attached. A Japan specimen in Kew of *A. squamigerum*, from Hyachine, Faurie No. 13583, 24th August 1894, differs somewhat, as to the frond, from his No. 8111 from the Forests of Yubari in Yezo, mentioned above, which quite matches Duthie's No. 14100 from Kashmir. On the same sheet with Faurie's No. 13583, is a rhizome, some inches in length, which is black, creeping and branching, not slender, with stipes in tufts ; but this is disconnected from the pale-coloured stipes of the mounted frond, and the stipes itself is broken. Even supposing that rhizome does not belong to that particular frond, it is valuable, as showing that the rhizomes of the Japan and Kumaun plants are the same. Of course, great similarity, or even identity, of rhizome does not of itself prove identity of species : some other characters must agree. In the "Synopsis" *A. crenatum* is said to have stipes "scattered, firm, erect," which implies a widely-creeping rhizome, but does not explicitly negative the supposition that it, like the Asiatic plants, also at intervals throws up fronds in tufts. The amount of "lamina" in a frond of *A. crenatum* is much less than in either the Himalaya or the Japan plants, and the sori seem never so long as in these : Baker says—"oblong, usually nearly straight, often double," and as to *A. squamigerum*—"linear, curved.....the lowest 2 lin. long." But the involucre in Japanese specimens of *A. squamigerum* are often very broad in comparison with the sori, and, as Mettenius said, membranaceous, tender, entire.

I lately asked Dr. H. Christ, of Basel, an eminent pteridologist, whether he could connect *A. squamigerum* with *A. crenatum*, giving him at the same time particulars of the recent discoveries in the Himalaya, and he replied as follows :—

"J'ai le premier (*A. crenatum*, Rupr.) en échantillons nombreux du Nord : Finlande, Scandinavie : plante petite : 3rd dec. stipe grêle : écailles peu nombreuses, mais larges : noires, segments petits, sores athyrioides, courts : plante fragile, rhizome presque filiforme, faible.

"J'ai la plante du Japon l. Faurie 11,578 et 13,583 : toutes les dimensions doubles ou triples : plants 6 Dec. et au deta, stipe jusqu' à 3 mill. en diamètre, écailles brunes, lanceolées, nombreuses : segments grands, sores jusqu' à un demi-centimètre, souvent diplazoides, rhizome plus épais, rampant, mais il semble que les stipes sont en peu en touffe et non solitaires comme dans la plante du Nord.

"Le plus grand échantillon est celui de Tosa, l. Makimo : fronde de 50 cent. sans tige.

"Je crois que la plante de "Inde" (que je n'ai pas vue !) doit être la plante du Japon, mais non la plante du Nord. Je ne nie pas la grande affinité des

deux plantes, et je suis disposé de voir dans cette dernière une *sous-espec* borale de la première.....”.

Colonel Beddome lately examined along with me all the material available in Kew, including specimens Mr. Gamble had lent me, and he came to the same conclusion as before, namely, that *Diplazium trotteri* (i.e., *A. squamigerum*) is certainly *A. crenatum*—the Kashmir plant being intermediate. The Kew bundle of *Dipl. squamigerum* he considers to be a mixture; one specimen being “certainly typical *A. crenatum* (tripinnate), but one from Japan, with very large prominent indusiae may be quite a different thing.” I think Colonel Beddome is mistaken in styling any of the forms—whether *crenatum*, *trotteri*, or *squamigerum* as tripinnate. No specimen I have seen is so: the utmost development is that the lowest pinnae are cut down, at the base, nearly to the secondary rhachis—one cannot even say to a winged rhachis. One Norwegian specimen of *A. crenatum* in Kew has sori longer than they usually appear, and some diplazoid; but, as most of the specimens are fully ripe, the involucres are generally obscured.

Since the above was re-written, I have again gone over the material, and while I still think all the Himalayan material must be identified as *A. squamigerum*, I now consider it possible that in spreading westward to Norway the Japanese plant has lost in length of sori, and become *A. crenatum*.

38. *A. multicaudatum*, Wall., Cat. 229. *A.* (*Athyrium*) *umbrosum* J. Sm., var. 2. *multicaudatum*, Wall. (*D. Jerdoni*, Bedd. F. B. 1., t. 327), Himalayas, Syn. Fil. 489. *A. multicaudatum*, Wall. Cat. 229, C. R. 502. *Diplazium umbrosum*, J. Smith under *Athyrium*, var. *multicaudatum*, Wall., Bedd. H. B. 190.

PUNJAB: *Chamba*—McDonell (in list of Chamba ferns identified at Kew); *Simla Reg.*—below Simla (*fide* Dr. King and Mr. Clarke), Blanford in “List”; *Sirmur State* 1882, in Herb. Hort. Calcutta.

N.-W. P.: *D. D. Dist.*—Near Mussooree, Dr. G. King 1869; 4-5030', Herschel 1879; Sowarna Nala 4-5000', Mackinnons 1878-79, P. W. Mackinnon and Hope 1881; “Mossy Falls” 5000', Hope 1885 and 87 and 1895; *Kumaun*—A. O. Hume; *Kāli Valley* 2-3000', Duthie 1884.

DISTRIE.—*Asia*: N. Ind. (Him.) *Nepāl*, Wallich, Sikkim and Bhotān; *Assam*—*Khasia* 1-5000'; *Chittagong* (in the plains of Bengal) 2000'—2000', Clarke.

I do not remember having seen McDonell's specimens from Chamba, but I believe his list to be generally correct. At Mussooree *A. multicaudatum* grows in beds, and fertile fronds are comparatively rare, and often sparsely soriferous: the creeping rhizome provides for the perpetuation of the species in each locality. None of Gamble's specimens from Sikkim seem quite the same as the Mussooree plant and some seem considerably different, having longer sori, with narrow persistent involucres. On the Mussooree plant it is difficult to find involucres, at least on mature fronds; but I can make out that many sori

are diplazoid ; and this is evident also on some of Gamble's specimens and on a specimen from Sikkim in Kew, Hook *fil.* Some of Wallich's Nepal specimens differ from the Mussooree plant (and from each other) : others are identical.

Mr. Baker, at p. 489, Syn. Fil., 2nd. Ed., under *A. umbrosum* J. Sm., says *A. (Dipl.) Griffithii*, No. 245, is perhaps a variety. I think there is not the slightest doubt that *A. Griffithii*, Baker, is identical with *A. multicaudatum*, Wall. I have not myself gathered *A. Griffithii*, but there is abundant material in Kew from which a conclusion can be arrived at. On several sheets (*ex* Herb. Hort. Bot., Calc.) of specimens collected by him in the Darjiling District at low elevations, his Nos. 9006 and 9079, 1869, Mr. Clarke has written, "Root-stock creeping extensively and throwing up solitary fronds : sori few, scattered, and few of these diplazoid." These are exactly the Mussooree plant, which is certainly Wallich's *A. multicaudatum*. On one sheet of this series, ticketed "*A. Griffithii*, Baker, Rishap, 3000', Darjiling, 4-9-69, No. 9006," and named finally by Mr. Clarke, on 11-1-79, *A. multicaudatum*, Wall., Mr. Baker has pencilled "*Madeiran umbrosum*." He has also pinned on this sheet a paper as follows :—"Clarke, Nov. 1875, seems to distinguish.

"1 Common species is (has ?) Allantodioid sori.

"Another sere (series ?) of similar structure, but white and with a scabrous stem and rhachis, appears to be *A. umbrosum*, J. Sm., but very unlike *A. australe*,

"*Australe*, Brack., from Thwaites—not Bengal, at all.

"Bengal fern which Dr. King and others call *A. australe* is for me *D. Jerdoni*, or *Griffithii* (I think the former). These two have creeping rhizomes which send up distant solitary fronds, the stipe rising through the earth."

I consider it quite a mistake to put this fern under *Athyrium umbrosum*, a Madeira fern, which is quite different in shape of frond, as well as of sorus and involucre—not to speak of rhizome. Specimens of *A. umbrosum* in herbaria are generally incomplete, and the descriptions say nothing as to the nature of the caudex ; but in a privately printed account of "An Easter Holiday in Gran Canaria and Madeira", 1893, written by one whom I know to be a keen observer and collector, I find this allusion to the plant—from which I gather that it is subarborescent, and must have a stout erect caudex :—"At one waterfall" (in the *Levada do furado*) "I noticed *Asplenium umbrosum* seven feet in length and as thick as a miniature tree." The young plants growing in the Kew houses have fronds in tufts, and certainly no creeping sarmentum. *A. umbrosum* has always, I think, an ovate or lanceolate frond : *A. multicaudatum*—a subdeltoid frond, with the lowest pair of pinnæ sometimes hardly less than the next above which are the longest. The involucre of *A. umbrosum* are described by Hooker and Baker as being "large, tumid, membranous." Those of *A. multicaudatum* are very small and narrow, so far as is visible. Beddome



gives *Dipl. Jerdoni*, Bedd., and *D. Griffithii*, Baker, as synonyms, and Clarke these, and also *A. spectabile*, Wall., Cat. 237<sup>A</sup>—a fern which is not mentioned in either the *Synopsis* or *Beddome*.

This seems to be one of the instances in which descriptions of old species are altered or re-written, in new books, so as to include subsequently discovered and sometimes very different plants, or to fit the theories of the later authors—a very reprehensible practice, in my opinion.

Subgenus—ANISOGONIUM, Presl.

39. *A. esculentum*, Presl.; Syn. Fil. 244; C. R. 503; *Anisogonium esculentum*, Presl.; Bedd. H. B. 192.

PUNJAB: *Chamba*—McDonell; *Kullu*—Trotter, twice collected, the 1-pinnate form.

N.-W. P.: *D. D. Dist.*—The Dehra Valley 1000'—2500': very common near water; *T. Garh.*—Ganges Valley, Duthie; *Kumaun*—5-7000', S. & W., Duthie, MacLeod.

DISTRIB.—*Asia*: N. Ind. (Him.)—Nepál, *Wallich*; Sikkim 3500', *Gamble*; plains of Assam and Bengal, and *Parasnáth Mt.* 2500', very common in Bengal. Centr. Prov. Ind.—*Pachmarhi*. S. Ind.—“Common in the plains on the western side, up to 3000' (*Beddome*). Ceylon. Malay Penins. and Isles. Java. Moluccas. Celebes. New Guinea. Tonkin. Hainan. Formosa. Hongkong. Philippines. Admiralty Isles. Samoa. Viti.

Fronds either simply pinnate, and then more or less lobed and toothed, or completely bipinnate with the pinnules again similarly lobed and toothed, but with a simply pinnate apex with up to 10—12 pairs of pinnae; or—with only one or two pairs below pinnate or partly so. The simply pinnate fronds are probably from young root stocks, and have pinnae varying from 2½ to 5 ins. in length and from ½ to 1¼ ins. in breadth; but I think both forms of frond are to be found on the same root-stock. In large bipinnate frond the lowest pinnae are very distant, and sometimes simple and short. The root-stock is, as the books say, subarborescent; the roots are black and wiry, and go deep into the ground. The plant loves ditches and swamps, and silty soil by the edges of streams. It is very common in the Dehra Dun where I have seen it in large bushes on the banks of rivers, and also in swamps among gigantic grasses—in separate plants, growing 9 to 12 feet high, with caudices 6—12 inches high.

The occurrence of this fern in North-West India was first recorded by me in the Catalogue of Ferns in the Saharanpur Herbarium.

Subgenus HEMIDICTYUM, Presl.

40. *A. Ceterach*, L.; Syn. Fil. 245; Cl. Rev. 504. *Hemidictyum Ceterach*, L.; Bedd. H. B. 44.

AFGHAN.—Griffith; *Kurram Vy.*—rocks overhanging Karriah River; *ran*, Aitch. 1897.

TRANS-IND., P. States; *Baraul and Swát*—3 stations 4-7000', General Gatacre.



KASHMIR : Jacquem.; Hook. fil. et Thoms. 1848; *Gilgit Dist.*—8000', Tanner, 1880; *Astor Dist.*—8-9000', Duthie; Sind and Jhelum Vys., Aitch., 1873 (?); Jhelum and Kishenganga Vys. 5000' and upwards, very common, Trotter, MacLeod; 'Iakht-i-Sulimán 6000', Lev., Trotter, MacLeod; Gund 7500', Ganmie; Ladrawan in Loláb, MacLeod; Barwan 5600', McDowell; *Kishtwar*—3500', Clark., 1876

PUNJAB : *Hazára*—Kagán Valley, 5000', Trotter, 1891; Malkandi, 4500', Duthie's collector 1897; Black Mt. 5000', Oertel, 1891. *Chamba*—Upper Chenab Vy. 8000', B den-Powell, 1879 (perhaps in Kashmir); Rávi Valley, 7000', common, McDowell, 1881; *Kullu*—Sartali Valley, Edge. ?

N.-W. P. : *T. Garh.*—Ganges Valley : Jangla 8-9000', Duthie, 1883.

DISTRIB.—*Europe* : in many parts of Germany, in Switzerland, the Tyrol, Hungary, Dalwatia, the Caucasus, Belgium, France, Spain, Italy, Greece. It is absent from Scandinavia, Northern Russia, Bohemia, and Austria" (*Britten*, in *European Ferns*). Lago di Garda, Austria, *Levinge*. In Britain, in all or nearly all the southern, northern, and western counties; "in Somersetshire and Devonshire it is especially abundant; in Scotland it is much less frequent"—chiefly in the West and South-West; frequent in Ireland, though local (*Britten*). *Asia*; Palestine, Persia. *Afr.* : Canaries, Madeira and Cape Verd Islands; Morocco, Algiers, Abyssinia, Cape of Good Hope.

#### Genus 21. ACTINIOPTERIS, Link.

1. *A. radiata*, Link. (for the type—*Acrostichum dichotomum*, Forshk., is the oldest name). Syn. Fil. 246. *A. dichotoma*, Bedd., C. R. 505. *A. dichotoma*, Forshk. (under *Acrostichum*), Bedd. H. B. 197.

AFGHAN. : *Kabul*—*vide* Clarke in "Review."

PUNJAB : *Delhi Dist.*—"Dry rocky places at Delhi and along the Jumna", Trotter in "List"; *Gurgaon Dist.*—Outliers of Aravalli Mts.; "abundant on north side of Khol Mt., between Karnál and Rewari, J. R. Drummond.

N.-W. P. : *Saharanpur Dist.*—Saharanpur, Dr. Jameson (in *Herb. Hort., Sahar.*), Duthie, 1881.

*Agra Dist.* : City of Agra—"Plentifully on old walls, 8th June 1825" (ticket in Wallich's writing!) : on another ticket—"197. *Asplenium radiatum*—Agra, super mures, 1825." in *Herb. Hort. Kew*; "Walls of City of Agra, 8th June 1825", Wallich?, in *Herb. Hort. Calc.*; Jharna near Agra, *Sahar. collectors* June 1842; *MoraZabad Dist.*—*vide* Clarke in "Review"; *Jhansi Dist.*—Duthie, 1883.

DISTRIB.—*Asia* : Mount Sinai, Arabia, Persia.—Cent. Ind.—Bagelkhand, *Hope*, 1860; Cent. Prov., Ind.—Khandwa Dist., *A. E. Lowrie*, very large; Rajputana—Tara-garh Hill, Mt. Abu 3750', *King*. Penins. of Ind., in dry rocky places below 3000 ft. elevation (*Beddome* in H. B.); Maisur 10" long. Ceylon. *Afr.* : Angola, Upper Egypt, Abyssinia, Socotra, Zambesiland, Macalisberg, Mascaren Isles.

*A. australis*, Link, seems to me a different species, but it is not found in British India, unless specimens in Gamble's collection, "from the outer hills of East Nepal, 1880," got by his native collector, be it. Specimens of the type, in Gamble's collection, from the Madras Presidency, show that the rhizome is sometimes procumbent, but with stipes very approximate : scales at base of stipe dark-brown, linear : scales sparsely clothing the stipe, paler, and hair-like.



## THE FERNS OF NORTH-WESTERN INDIA.

Including AFGHANISTAN, the TRANS-INDUS PROTECTED STATES, and KASHMIR : arranged and named on the basis of Hooker and Baker's *Synopsis Filicum*, and other works, with New Species added.

By C. W. HOPE.

(Continued from page 266 of this Volume.)

### PART III.—THE GENERAL LIST—(continued.)

Genus 22. ASPIDIUM, Sw. (in part), R. Br.

Subgenus POLYSTICHUM, Roth.

1. **A. Lonchitis**, Swartz ; Syn. Fil. 250 ; C. R. 505. *Polystichum Lonchitis*, Sw., Bedd. H. B. 203. Hook. Brit. F. t. 9.

TRANS-IND. STATES : Baraul 10,500-11,000', Harriss 1895.

KASHMIR : Jacquem. and S. & W. (in Herb. Brit. Mus.) ; Gulmarg and Sonamarg 9-11,000', Dr. J. L. Stewart, Levinge, Trotter ; elsewhere—Gilgit, and W. & S. Kashmir 8-12,000', Duthie, McDonell, MacLeod.

DISTRIB.—*N. Amer.* Greenland—Disko Bay ; Brit. Columbia—Cascade Mts. 5-6000' ; United States—southern shore of Lake Superior and northwards (Written). *Europe*—North to Centr., more sparingly in S. Europe ; Brit. Isles—N. and Centr. Scotland ; Durham, Westmoreland, and Yorkshire ; Carnarvonshire ; W. and N.-W. Ireland, very local. *Asia* : Asia Minor, Siberia, Turkestan.

Mr. Clarke says :—"The single Himalayan specimen at Kew (Jacquemont's) has been marked *A. Lonchitis* by Moore ; but others have marked it *A. auriculatum*. H. C. Levinge's example is typical *A. Lonchitis*." The additional localities in Kashmir, summarised above—ten or twelve in number—show that the plant is not uncommon in the western and southern parts of that State. The dimensions given in the Synopsis, namely, fr. 12-18 in. l., 1-2 in. br., are exceeded in Kashmir : I have a frond from MacLeod, with narrow pinnæ, which measures 15 in. by 3 in., and another 18 in. by 2 in. ; but there is a frond in his collection 28 in. in length, the breadth of which I omitted to note. The pinnæ are lobed : each vein after leaving the costa branches ; and in well-developed fronds each group of veinlets occupies a shallow lobe, the apex of which is a mucronate tooth on the longest veinlet ; and there are smaller teeth at the points of the other veinlets.

2. **A. lachenense**, Hook. ; Syn. Fil. 250 ; C. R. 506. *Polystichum lachenense*, Hook., Bedd. H. B. 203, F. B. I., t. 32.

KASHMIR : Palgram 13,000', C. B. Clarke, No. 31051, 49-76 ; *Gilgit Dist.*—Gor 15,000', Tanner 1880 ; *Liddar Vy.*—above Kainmal 12,000', Duthie No. 13131, Masjid Vy. 12-13,000', Duthie No. 13198, and Sonsal Nala 13-14,000', Duthie No. 14128—all in 1893.

PUNJAB : *Chamba*.—Ravi Valley, Cheni Pass 12,000', McDonell 1892.

*N.-W. P.* : *T. Garh.*—Damdār Vy. 12-13,000, No. 106', and Dudu Glacier Moraine, 4-15,000', Duthie 1883 ; near Jaula, under Srikanta, 15-16,000', No. 397, and above

Chinpul 14-15,000', No. 406, Duthie 1883 ; "Kumaun 9678 ! in Herb. Schlagentweit," (note by Mr. Baker on a Sikkim sheet in Kew) ; Rálam Valley 12-15,000', Duthie No. 3616, 23-8-'84, by Nipchang Glacier in Darma 16-17,000' and Kutti Valley 12-13,000', Duthie No. 3768 (in part), 18-9-84.

NEPAL W.—Opposite Buddhi Village 10-11,000' and Nampa Gadh 12-14,000', Duthie 1886.

DISTRIB.—Asia : N. Ind. (Him.)—Sikkim 13-16,000', *Drs. Hooker, Thomson and Anderson*.

3. *A. Duthiei*, n. sp. Plate VI. (See Part II., p. 532.)

4. *A. marginatum*, Wall. Cat. 366. *A. auriculatum*, Sw.,  $\beta$ , *A. marginatum* Wall., Syn. Fil. 251 ; C. R. 207. *Polystichum auriculatum* (Linn. under *Polypodium*), var.  $\beta$  *marginatum*, Wall., Bedd. H. B. 204. Plate XXVII.

PUNJAB : Chamba—McDonell, loc. ? ; Simla Reg.—"Above Simla," Colonel Bates, in Herb. Kew ; Bisáhir—Kunáwar, *vide* Clarke in Rev ; Kangra V. Dist.—Harrbágh, Edgew. in Herb. Kew ; Dharmasála 10,000', C. B. Clarke No. 24,51, 1874.

N.-W. P. : *T. Garh.*—Lev. 1872 ; Kidár Kánta Mt. 8-9000', Herschel 1879, 10-11,000', Duthie 1879, and between Manma and Barahát ; *Brit. Garh.* 7-11,000' (two stations) P. W. Mackinnon 1881 ; Kumaun—above Dwali 9,000', S. and W. 1849 ; Mundul 7,000', Davidson 1875 ; Gori Valley—below Askot 3-4,000', Duthie No. 3629, 1884 ; Pindar Gorge—above Dwali 8,500', Trotter 1891 ; Mangalia Gor 7,500', MacLeod 1893.

DISTRIB.—Asia : N. Ind. (Him.) Nepal, *Wallich* ; Sikkim and Bhotán.

I have not the slightest hesitation about separating this plant from *A. auriculatum* Sw., for not only the shape of the pinnae, and the cutting of them, but the venation is different in the two. Also I think the stipes of *A. auriculatum*, are the shorter, and the scales on them are pale drab instead of rich brown, with darker centres ; they are not so broad and ovate as those on *A. marginatum*, and they do not extend so far up the stipe and rachis. In *A. marginatum*, there are fibrillose or hair-like scales mixed with the broad ones. The rhizomes of both species are erect or suberect, and stipes densely tufted. *A. auriculatum* is thinly herbaceous in texture, and dries a dull dark green colour : *A. marginatum* is very coriaceous and shiny, with a metallic sheen on the upper surface. The under surface of *A. auriculatum* is nearly glabrous, having only a few small linear scales on the costa : that of *A. marginatum* is always more or less covered with a myriad of very minute pellate or broadly ovate, short, brown, adpressed scales, situated on the veins and veinlets, which, without a lens, look like mere dots : but on some large fronds I see fibrillose or chaffy scales, like those on *A. lentum*, Don (see below). The "Synopsis" says the lower veinlets of *A. auriculatum* are in groups of three, but nothing as to those of *A. marginatum*. I find that the system of venation is quite different in the two plants. In *A. auriculatum* the veins are obscure on the upperside ; but they can be made out on the underside in young fronds, and



it is then seen that they are very few in a group, and that the sori are generally placed on the short *inferior* veinlets of the groups which take off nearer the costa than the margin, and that these veinlets seldom, if ever, go beyond the sori—see Beddome's drawing, F. S. I., t. 120. Occasionally the sori are medial on a vein which reaches the margin. In *A. marginatum* the veinlets are so numerous in the narrow groups that their number is not easily counted with a lens; it appears, however, to be from five to seven, and all reach the margin. All round the margin is a pale-coloured fringe, mucronately toothed in correspondence with the veinlets, from which feature I conjecture Wallich named the plant. In *A. auriculatum* I see no such margin. In both species the auricle at base of pinnæ has a distinct costa or pinnated vein; but in *A. marginatum*, this auricle is broader and has more veinlets than in the other species. Finally, though in *A. auriculatum* large fronds are distinctly but shallowly lobed or serrated in correspondence with the groups of veinlets, even the smallest in *A. marginatum* are generally so; and in large fronds this is carried so far that the frond becomes quite bipinnatifid nearly to the secondary rhachis,—the distance between the groups of veins becoming greater in order to admit of this. I first observed this in some of Mr. P. W. Mackinnon's specimens from British Garhwal, which, when collecting them, I believe he identified with the simple narrow form and named *A. auriculatum*, var.  $\beta$  *marginatum*, Wall., or *A. aculeatum*, var. In one frond I have, 9 in. l. by  $2\frac{1}{2}$  in. br., the pinnæ are merely lobed, but in the lowest pair the auricles are free to the midrib; in another (apex wanting), probably 12 in. by  $3\frac{1}{2}$  in. the seven lowest pairs of pinnæ are cut down nearly to the rhachis into rhomboidal-ovate segments, and the upper pairs are diminishingly cut. In two other fronds, 15 and 16 in. l. by 5 in. br., the auricles are quite free, and the pinnæ are less cut towards their acuminate apices, and towards the apex of the frond. Each lobe, or segment, has a costa, and up to eight veinlets on either side, which do not fork; all run out to the margin. The segments more or less overlap each other. There seems to be a small spinulose tooth for every veinlet, and a larger stiff one for the principal vein of each group. But none of these four fronds is fertile. I should when I received them, have put the three last mentioned fronds under *A. aculeatum*, Swartz, had not Mr. Mackinnon gathered them for *A. marginatum*, and but for the characters given above, which agree with those for that species. A specimen I have from Sikkim, collected by Mr. Lvinge, has stipe  $8\frac{1}{2}$  in. long, and frond  $10\frac{1}{2}$  in. long by  $2\frac{3}{4}$  in. wide near the base, with up to eight pairs of distinct, toothed lobes in the pinnæ, the lowest superior on the lowest pinnæ quite free. This has the characteristic metallic sheen and other peculiarities above described.



J. N. Fitch del.

Chitra Silpi Co Lith.

ASPIDIUM MARGINATUM Wallich.

1. From a Kumaun plant. Pinnae, upper and under surfaces; with enlargement of margin and scale from under surface, enlarged.
2. From a Kaugra VV plant. Pinnae, from two fronds of same plant, with enlargements of margin and scale from under surface.
3. From a Sikkim plant. Pinnae, with enlargements of margin, and scale from under surface.
4. From a Brit. Garhwal plant. Pinnae, with enlargements of margin and scale from under surface.





Going through the collection of Ferns in the Kew Herbarium, I have found no difficulty in distinguishing between these four species—

1. *A. auriculatum*, Swartz.
2. *A. marginatum*, Wall.
3. *A. lentum*, Don.
4. *A. obliquum*, Don.  
= *A. caespitosum*, Wall.

I have gathered only the two last of these, and taking them only, whether in the field or in the Herbarium, I think it would not occur to a casual observer that they were so neatly connected as to be merely varieties of another fern; they are as different from each other as any two species of the same genus can be. But large fronds of No. 4, as seen in a Herbarium, have a superficial resemblance in cutting to fronds of No. 1; and there is at least one character in common between No. 4 and No. 2. Also there is one character common to all four species, which is that they all have auricled pinnae; but that is the almost invariable characteristic of the subgenus (or genus) *Polystichum*. I take it that it was the result of No. 1 having been given the specific name—*auriculatum*, by Swartz that species subsequently described and differently named by other collectors and authors, but which also were auricled, were afterwards, by authors who had not gathered the plants, united with, or given as mere varieties of the first described plant, *A. auriculatum*. Had Swartz named his species after any other feature of the plant than its auricle, or after, say, "The man in the street," this confusion between the four species might never have arisen, and certainly could not have between Nos. 3 and 4 at least. The chief differences between Nos. 1 and 2 have been mentioned above, and the distinguishing characters of Nos. 3 and 4 will be mentioned in their proper places. Returning to No. 2, *A. marginatum*, I have to add that I have the simple form with fronds varying in size from 4 in. l. by  $\frac{3}{4}$  in. br. to 14 by  $4\frac{1}{2}$  inches; and one incomplete frond from Sikkim must have been at least 20 inches in length; in these the auricle is not free, and the rest of the pinna is not very deeply lobed. The more compound form has fronds not longer than the other, but often much broader,—9 inches broad in one specimen in Kew, from the Rattong Valley in Sikkim (J. D. H., Jany. 7th), and quite bipinnate, though the secondary rhachis is winged in the upper part of the pinnae. The pinnules are rhomboidal-ovate, sharply and stiffly spined on the apex, and once or twice spined on the sides.

My Chamba specimens, from Mr. McDonell, are whole plants, with three to seven fronds each, and they show the plant to be dimorphous, with the fertile fronds considerably smaller than the sterile, but with the stipes not much shorter.



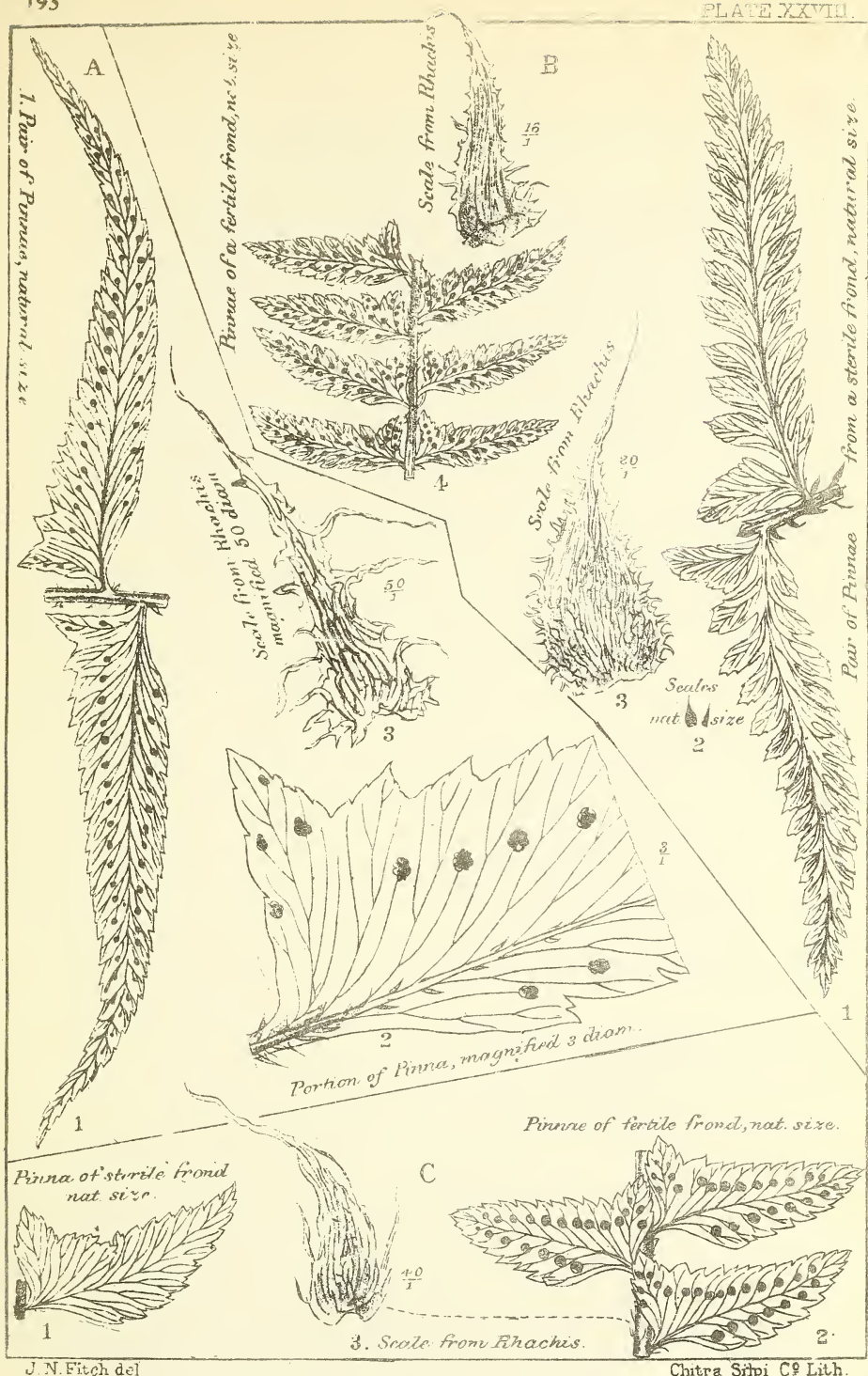
5. *A. lentum*, Don, Prod. Fl. Nep., p. 4. *A. auriculatum*, Sw., & *A. lentum*, Don; Syn. Fil. 251. *A. auriculatum*, Sw., var. 4, *lenta* (sp.) Don, Cl. Rev. 507. *Polystichum auriculatum*, Sw. var. ♂ *lentum*, Don, Bedd. H. B. 204. F. B. I., t. 136. Plate XXVIII, B.

PUNJAB: *Chamba*—McDonell, in List of Chamba Ferns identified at Kew; Kangra V. Dist.—Harrahagh, Edgew. in Herb. Kew, ex. Herb. Hort. Bot. Calc., named *P. radicans*.

N.-W. P.: *D. D. Dist.*—Sowarna Nāla 4-5,000', Mackinnons 1878-79; *T. Garh.*—Bhatauli, between Mussooree and the Jumna on road to Chakrata 4,500', Hope 1886; Phedi 4-5,000', Duthie 1881; collected also in 1878 by Herchel and Duthie and ticketed by both "Mussooree," as is also a specimen from H. Chase, 8,000' elevation, recd. 1878 (Mr. Baker's ticket): near Mussooree must be meant in these cases; below Mussooree 5,000', Gamble 1895 (at Bhatauli probably); *Kumaun*—Rāroganga Valley 2,600', S. & W. 1848, No. 2, *Aspid. radicans*; near Askot 4-5,000', and Gori Valley 4-5,000', Duthie 1884; Chipila, coll. Ramsukh (Duthie's collector) 1888; near Lohughāt 5,000', Trotter 1891; Gori Ganga Valley—Buin 7,500', MacLeod 1893.

DISTRIB.—*Asia*: N. Ind. (Him.) Nepāl, *Wallich*; Sikkim and Bhotan, common Assam—Khasi Hills from 1,500' upwards.

This is *A. ocellatum*, Wall. Cat. 360, in Herb. 1823, "Napalia 1820." D. Don's name was the first published, but his description was written from Wallich's specimens collected "in Napaliæ alpinus." It is also Hooker's *A. auriculatum*, var. *subbipinnata*, Sp. Fil., Vol. IV., p. 11. It is strange that neither Don nor Hooker mention the chief distinguishing character of this species, which is indicated by the specific name given to it by (?) namely, *radicans*. Clarke says—"This fern frequently produces a subterminal rooting bud on the main *rhachis*; then it is called *Polystichum radicans*," but neither Baker nor Beddome mentions this character; though it pertains to every plant I have seen, though not to every frond, and neither *A. auriculatum*, nor its other so-called varieties—*A. marginatum*, Wall. and *A. obliquum*, Don—ever have it, so far as I know. I have a frond from Tehri Garhwāl, which has not only a young plant with four pinnated and seriferous fronds growing from its apex, but also another growing plant on the lowest pinnæ of all, near its apex. The buds and young apical plants are densely clothed with pale brown scales. The cutting of *A. lentum* varies a good deal, but I think it is always deeper than that of *A. auriculatum*, and of the simple form of *A. marginatum*, and is from one to two-thirds downwards to the midrib, except in Strachey and Winterbottom's Kumaun specimens which, though proliferous, have nearly entire pinnæ. The lobes are obliquely rounded and pointed, with generally only one aristate tooth to each. The veins are pinnate in the lobes, two to five veinlets in a lobe, one or more of which forks. The sori are small, and uniserial, placed on the inferior veinlet of each group, about half-way between costa and margin, and the sometimes quite free falcate auricled segment next



J. N. Fitch del

Chitra Sitpi Co Lith.

A. ASPIDIUM AURICULATUM, Swartz:

B. ASPIDIUM LENTUM Don.

C. ASPIDIUM OBLIQUUM, Don.



the main rhachis has a pinnated costa with a row of sori on each side of it : involucre rather fugacious. The auricles are sometimes themselves auriculate. The scales on stipe are large, broad, dark-brown with lighter margins, or sometimes pale concolorous, mixed with which are pale fibrillose scales ; and both kinds of scales extend up the main rhachis, diminishing in size upwards. The costa and veins of the pinnae are, on the underside, to some extent clothed with small fibrillose or chaffy scales, which, being inconspicuous, are liable to be overlooked. These are quite different in shape and appearance from the much smaller round or ovate scales, which generally thickly cover the under surface of *A. marginatum*.

6. *A. obliquum*, Don, Prod. Fl. Nep. 3. *A. auriculatum*, Sw. 2, *A. obliquum*, Don., Syn. Fil. 2nd ed. 493. *A. auriculatum*, Don., var. 3 *cæspitosa*, Wall. Cat. 367, Cl. Rev. 507. *Polystichum auriculatum* L., var.  $\gamma$  *cæspitosum*, Wall., Bedd. H. B. 204. F. B. I., t. 33. Plate XXVIII, C.

PUNJAB: *Chamba*—Ravi Valley 7,000', McDonell ; *Kullu*—7,000', Trotter, Coventry. *Simla Reg.*—above Simla, Colonel Bates ; Edgew. 1834 ; near Simla 4,000' (?) Herschel ; "very rare within my limits and area. I have found it but once, at 4,800'." Blanford in List.

N.-W. P. : *D. D. Dist.*—Jaunsar 7-8,000', Gamble ; Mussorie 5-6,500', plentiful in several places on wet rocks in forest ; *T. Garh.*—Kidar Kanta Mt. 8-9,000', Herschel ; *Kumaun*—near Naini Tal 6,000', Hope 1861, Levinge 1875.

DISTRIB.—*Asia* : N. Ind. (Him.) ; Nepal *Wallich* ; Sikkim and Bhotan. Assam—Khasia 3-4,000', very common ; N. Manipur 3,500', *Clarke*.

The stipes in this species are densely tufted, slender, and, except for a few greyish brown scales near the base, extending a short distance up the main rhachis, are, with the rhachises and the surfaces of the frond, glabrous. The plants vary much in size, according to situation and the degree of moisture they are favoured with.

Mr. Baker says—"Seldom above  $\frac{1}{2}$  ft. high": the other books give no dimensions. I have fertile fronds with stipe and frond together less than 2 in. high, by  $\frac{1}{2}$  in. broad, and all sizes between that and a total height of 22 inches, of which the stipes are 8—9 inches, and the fronds 12—13 in. long by 2—2 $\frac{1}{2}$  in. broad. The shape and cutting of the pinnae vary very much, from rhomboid-ovate, nearly as broad as long, in small plants, to 1 $\frac{1}{2}$  in. long by  $\frac{1}{2}$  in. broad, sharply, pointly and distinctly auricled at the base and greatly cut away on the inferior side, in large plants. The pinnae are sometimes merely crenate, sometimes narrow and falcate, and the barren fronds are sometimes sharply toothed at the end of every veinlet. The pinnae are hardly ever distinctly lobed, and occasionally they are in shape almost like the simple form of *A. marginatum*.

The system of venation in *A. obliquum* is the simplest in the whole group, and in the absence of distinct lobes to the pinnae may best be described as—pinnate on the costa, with veinlets forking once or twice. The venation is



rather obscure: the superior veinlets, which alone are usually soriferous, often appear not to extend beyond the sori, but sometimes reappear near the margin and run out to a small tooth near the sinus where there is a trace of a lobe. In large pinnæ the auricle has a pinnate costa and double row of sori. A distinguishing character of the plant, though shared with *A. marginatum*, is its sub-dimorphism. The fertile fronds are generally much shorter than the sterile ones, which is contrary to the general habit of dimorphous ferns. Sometimes this may be only apparent, and be due to the smaller fronds of the previous year being persistent after new sterile fronds have sprung up; but I have short young sterile fronds also. Occasionally, in large plants at least, young fertile fronds are seen as long as the sterile ones, which are generally in the majority. Whether the dimorphism be real or only apparent and not invariable, it is a character of the plant.

7. *A. ilicifolium*, Don., Prod. Fl. Nep., p. 3; "Fronde pinnatâ-lanceolatâ; pinnis alternis ovato-oblongis coriaceis rigidis mucronatis nitidis brevissime scipitatis bi-v-tricuspidatis spinulosis subtus lepidotis at latus superius lobo lata auriculatis, stipite rhachique semi-teretibus squamosis. Hab. in Nepalia, Wallich.

"Frons sesquipedalis, Pinnæ pollicem v. sesquipollicem longæ, seminuciam latæ. Sori magni, superiores biseriati, inferiores imordinate associati."

*A. ilicifolium*, Don, Syn. Fil. 251; Cl. Rev. 508. *Polystichum ilicifolium*, Don, Bedd. H. B. 206. F. B. I. t. 31.

PUNJAB: *Chamba*—Râvi Valley: Sao Nala 3,000', McDonell; *Kangra Vy. Dist.*—Dharmasala 10,000', C. B. Clarke; *Kullu*—Outer Seorâj 7,000', Trotter; Simla Reg.—ridge E. of Simla; Theog to Baghi 5-10,000', common: Edgew., Bates, Falconer ("N.-W. I."), Gamble, Collett, Blanford, Hope, Trotter, Bliss, Lace.

N.-W. P.: *D. D. Dist.*—Jaunsar; Seshol 8,500', C. G. Rogers; *Garhwal*—Pâbar Vy, Jacquem., Nos. 722 and 2253; *T. Garh.*—Nâg Tibâ Mt., Mackinnons 1878, W. Gollan 1881; Kidâr Kânta Mt., 10-11,000', and Bok Mt., Duthie 1878; Jamnotri 9-10,000', Duthie 1883; Rikishin 9,000', C. G. Rogers 1891; Gangar 7,500', Gamble 1893; *Brit. Garhwal*—Ramri 8-9,000', Duthie 1885; *Kumaun*—R. Blink. (*Aspidium pungens*, Wall. in Herb. 1823); Madhari Pass 9,000', S. & W.; Pinsara, Davidson 1875; Kali Vy. 8-9,000', and above Sosa 8-10,000', Duthie 1884-86; Gori Ganga Vy. 9,000', MacLeod 1893.

DISTRIB.—*Asia*: N. Ind. (Him.), Sikkim 7-10,000'; Nepal, Wallich.

I have quoted Don's description as showing that the plant he described as *A. ilicifolium*,—which is Wallich's *A. pungens*, Cat. 368,—had short pinnæ merely lobed and auricled. I cannot admit that the pinnæ are ever again pinnate as Beddome says they are, though the auricle is sometimes quite free; indeed, I think Beddome would now put his more compound plants under his

var. *acanthophyllum* (sp. Franchet) of *A. aculeatum*, which—opposing Baker, who in his Summary of New Ferns accepts it as a species—he sets up in the Supplement to his Handbook.

In the "*Synopsis Filicum*" this fern is characterised as "quite doubtfully distinct from some of the forms of *auriculatum* and *aculeatum*." I know no form of *A. auriculatum* which *A. ilicifolium* in the least resembles; and it certainly is very different from the three species I have above separated from it; and Mr. Clarke suggests no resemblance to any of these, though he says there are intermediates between *A. ilicifolium* and *A. aculeatum*, which no one up to the time when he wrote had ventured to name. There is no doubt a great resemblance to *A. rufo-barbatum* Wall. in the cutting (of segments, not of frond) and texture of *A. ilicifolium*, and since Mr. Clarke wrote M. Franchet has "rushed in" and named a Chinese plant *A. acanthophyllum*. On seeing the scrap of this in Kew I adopted this name for a somewhat common N.-W. Himalayan plant, to which I had been giving the variety names of *contortum*, and, afterwards, *pseud-ilicifolium*. Holding to my present scheme of admitting no varieties in ferns except cultural ones, and not being able to see that any one of these three ferns is a mere form of another of them, I keep them separate as species; and I would describe *A. ilicifolium* as follows:—

"*St.* tufted, often densely so, 2—9 ins. long, slender, clothed sometimes sparsely with large broad scales, mixed sometimes with fibrils; *fr.* 6—10 ins. long  $\frac{5}{8}$  in. to  $\frac{1}{4}$  in. broad; *pinnæ* subdeltoid or broadly lanceolate,  $\frac{3}{8}$ — $\frac{5}{8}$  in. long, apex mucronate, with a large mucronate auricle below generally nearly, and sometimes quite, free in large specimens, and several mucronate lobes above, *pinnæ* becoming very distant and rather smaller towards the base of frond; *texture* very coriaceous; both surfaces naked, except for a few scales on the underside of the costa; *rhachis* slender, clothed with narrow hair-pointed scales; *veins* immersed—best visible on upper side, forked once or twice in the lobes; *sori* one in each lobe, and in two rows in the auricle, large in proportion to the size of the segments."

Blanford was sceptical as to the claim of this fern to specific rank, and considered it an alpine form of *A. aculeatum*, graduating into *A. rufo-barbatum*; but he evidently included *A. acanthophyllum*.

8. *A. acanthophyllum* Franchet, in Bull. Bot. Soc. France 1885, 28; Baker in Summary of New Ferns, Ann. Bot., Vol. V., No. xviii. *Polystichum aculeatum*, var. *acanthophyllum* (Franchet), Bedd. Suppt. H. B. 43. Plate XXIX.

PUNJAB: *Hazar.* Dist.—Black Mt., Trotter in List; near Chittabat, Gatacre 1888; *Chamba*—Dalhousie 7500', Ravi Vy. 8000', McDonell; "Chamba" J. Marten 1898;

*Kangra Vy. Dist.*—Dharmśāla 5500', Trotter; *Kullu* 6-8000', Coventry; *Simla Reg.*—Simla, Hope 1871; Hat Mt. 9000', Cheog Forest 8000', Mahásu 8000', Gamble 1876-78; Forest above Bulsun, Coll. 1877; Simla 8000', common, Blanford in List (under *A. ilicifolium*, "bipinnate form"); near Mashobra 7000', and Theog. 8000', Hope 1886; Bāghi 9000', Trotter 1887; Simla—Jako Mt. 7700', The Glen and Mashobra, Bliss; Bāghi Forest, Bliss 1891; Raiengar Forest 8000', Gamble 1898.

N.-W. P.: *D. D. Dist.*—Jaunsar—Kathiān 7000', and Mandāli Forest 8000', Gamble 1891-93; *T. Garh*—9000', Lev. 1872, Datuni 7000', Gamble 1893; *Kumaun*—Khāti 7200', S. & W. 1848; Kāli Vy. 7-8000', and near Sosa 8-9000', Duthie 1884-86; Dankuri to Khāti 75-8000', Trotter 1891; Gori and Rāmgangā Vys. 7-8500', MacLeod 1893.

DISTRIB.—*Asia*: N. Ind (Him.) Sikkim 12,000', *Livinge's* collr. 1882. China—Yünnan, *Delavay*.

I noted this fern, as having a distinct individuality, when at Simla in 1886; and when at Kew in 1888 I found a poor specimen or two, from Yunnan, named as above, which seemed to be the same. The stipes are always short—often much shorter than Beddome's length, 3—4 ins. The pinnae are never so short and simple as those of *A. ilicifolium*. The fronds seem seldom to grow straight up, but curve sideways: Trotter describes them as—"sickle-shaped, radiating, spreading-out on the surface of rocks, and connecting *rufo-barbatum* with *ilicifolium*." Sometimes the fronds are bent like the upper part of a note of interrogation (?) I think it necessary to give this frond specific rank in order to prevent *A. ilicifolium* being said to pass into *A. rufo-barbatum*, to which it is totally unlike in everything except shape and spinosity of the ultimate segments.

9. *A. Thomsoni* Hook.; Syn. Fil. 251; C. R. 508. *Polystichum Thomsoni* Hook., Bedd. H. B. 206, F. B. I. t. 126.

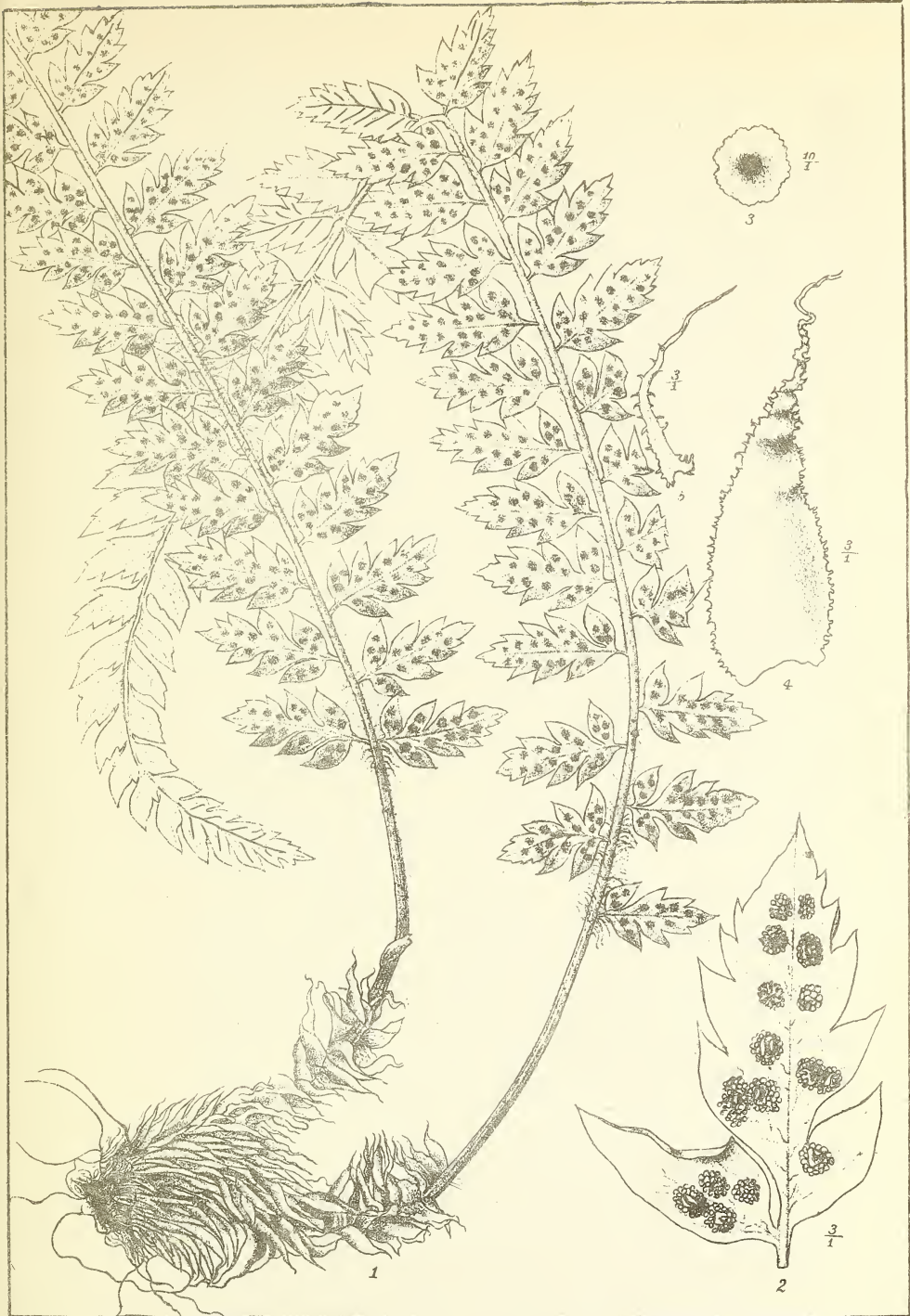
KASHMIR: Pushāna 6500', Winterbottom 1847, No. 81; Chittapāni Vy. 75-8000', Trotter; *Kishtwar*, W. S. Atkinson 1872.

PUNJAB: *Chamba*—Upper Chénab Vy., Chiri 10,000', Baden-Powell 1879; Rāvi Vy., Chatri Forest 6000', McDonell 1882; Sach Pass 7500', Rāvi Vy.—Barmaur 7000', and 9000', McDonell 1885; *Kullu*—Babbu Pass 10,000', Trotter 1887; *Simla Reg.*—ridge E. of Simla, Matiana to Hatu Mt., and Kunāwar, 8-10,000', T. T.; Bates Gamble, Blanford, Hope, Trotter, Bliss, Lacey; Simla—The Glen, 6-6500' Bliss 1890.

N.-W. P.: *D. D. Dist.*—Jaunsar, Deoban 9000', Herschel 1879, Mrs. J. Sladen 1880; Lokandi 8-8500', Mandāli Forest 9500', and Karāma 9500', Gamble 1891, '93 and '94; Mussooree, Dr. Bacon, Duthie 1877. (These two last are probably from Tehri Garh; I have never seen this species from in or near Mussooree.) *T. Garh*. 7-10,000', Livinge, Mackinnons, Duthie, Gollan; *Brit. Garh*. above Ramri 8-9000', and near Kuāri Pass 11-12,000', Duthie 1885; *Kumaun*—Ralam 12,000', Tola, Rilkoṭ, and near Dwāli S. & W.; Byāns—Kali Vy. 9-12,000' (5 stations) Duthie 1884-86; Pindar Gorge—near Dwāli 8000', Trotter 1891; Rāmgangā and Gori Vys. 5-10,000', Macleod 1893.

DISTRIB.—*Asia*: Thibet—Indus Vy., Shayok, 7-3000', T. T. N. Ind. (Him.) Sikkim 9-13,000'.





N. E. Brown delt.

K. P. Dass lith.

ASPIDIUM (§ POLYSTICHUM) ACANTHOPHYLLUM Franchet.

1. Part of a plant, natural size.      3. Indusium, enlarged 10 diam.  
 2. Pinna, enlarged 3 diam.      4. Scale from the base of the stipes, enlarged 3 diam.  
 5. Scale from rachis, enlarged 3 diam.





I cannot see much, if any, resemblance of this fern to *A. Prescottianum* Hook; though Mr. Clarke says the two species are no doubt very close, and Colonel Beddome that *A. Thomsoni* is very near the smaller forms of *A. Prescottianum*, and that it is very probable that they are only varieties of the same plant (name not stated). *A. Prescottianum* is a comparatively large fern, and grows to dense bushy thickets; it is very scaly all over, shaggy almost. *A. Thomsoni* is a small plant, growing on rocks, or on rocky ground in forest, but each plant separately, so far as I have seen. The largest plants of *A. Thomsoni* I have seen are Mr. Gollan's from Nag Tiba Mt. in Tehri Garhwal, one frond of which is  $17\frac{1}{2} \times 1\frac{1}{2}$  ins., and it is just as much *A. Thomsoni* as is the smallest of all those cited above. But there is difference between some of these: McDonell's from the Sach Pass in Chamba and Duthie's No. 101 from the Ganges Vy. have stipes and rhachis almost glabrous, and quite a different cutting of frond from that of most others—like some one's *var. alpina* of *A. Prescottianum* from Sikkim; and some at least of the sori of Duthie's plant are nephroid. These cannot, however, be Clarke's *var. gracilis* (*Lastrea gracilis* Moore), for that is said to have fronds smaller than those of typical *A. Thomsoni*, whereas Duthie's is a large plant with fronds 10 ins. long by  $1\frac{1}{2}$  ins. broad. Another form has broadly falcate and auricled pinnæ with sharp teeth, much cut away at the base on the lower side; while another has straight, almost dimidiate pinnæ, and segments spreading on both sides; but these are intermediate forms, and the habit of all is alike.

[*A. aculeatum* Sw. is attributed in all the books to the Indian Region. The *Synopsis* says—"Hab.—Throu. out the world"; but gives as a synonym *A. squarrosum* Don (*rufo-harbatum* Wall.), with "has the rachis densely clothed with reddish-brown fibrillose scales," and we are left in doubt under which of the three varieties it recognises, namely  $\alpha$  *A. lobatum*, Sw.,  $\beta$  *A. aculeatum*, Sw. and  $\gamma$  *A. angulare* Willd., *A. squarrosum* ought to be placed. From the fact that *var. \beta* is given in the *Synopsis* as a variety of *A. aculeatum* Sw., i.e., as a variety of itself, I gather that the species 18, *A. aculeatum* Sw., of the *Synopsis* is a theoretical conception of the authors'; but it ought to have been given a distinctive specific name, instead of being fathered on Swartz, and I would suggest *metaphysica*, *hypothetica*, or *theoretica*, or some equivalent name, to indicate that the plant has no existence in nature. Swartz did not include *A. lobatum* under *A. aculeatum*, but gave it as a separate species, with only "Anglia" as the habitat.

Mr. Clarke says *A. aculeatum* Sw. (*var. \beta* of the *Synopsis*) is very common in the Himalaya and Khasia, alt. 2,000'—13,000'; and he

gives *A. rufo-barbatum* (sp.) Wall. Cat. 369, as var. 2 (out of 6 varieties), and says it is common from Kashmir to Bhotán, and also in the Nilgiris (but not from Khasia). Beddome, in his Hand-book, says *Polystichum aculeatum* Sw. is found "throughout the Indian Region on the mountains," (also throughout the whole world); and he gives (among 7 varieties) var.  $\gamma$  *rufo-barbatum* (Wall. Cat. 369), F. S. I., t. 121, with habitats—"Nilgiris and Western mountains of South India; Himalayas, from Kashmir to Bhotan."

As to the other varieties mentioned in the *Synopsis*, Clarke gives as his var. 1, "*lobata* (sp.) Engl. Bot., t. 1563. Fronds narrowly lanceolate; pinnae hardly pinnate, the lower secondary pinnae sessile or decurrent. Throughout the Himalaya, but much more rare than *A. aculeatum* type." Beddome quotes verbatim from Clarke, but omits the final remark as to rarity. These authors appear to limit the distribution of *A. lobatum* to the Himalaya.

Var.  $\gamma$  *angulare*, Willd., of the *Synopsis* is not even mentioned by Mr. Clarke, and this seems to have led Colonel Beddome to give merely "Nilgiris and Western mountains of South India" as the habitats of his var.  $\alpha$  *angulare* (Presl., Newm. 173), which he thus describes:—"Lax and of thinner texture" (than of what?), "pinnules smaller, more numerous, orbicular, rhomboid, mostly auriculate, the serratures setiferous rather than spinulose." t. 122. This seems to apply to much of the Himalayan material which Clarke seems to have considered as typical *aculeatum*, but which is all quite different from what is considered as *A. aculeatum* by European botanists.

Clarke's var. 3 *semifertilis* (base of the frond fertile, upper  $\frac{1}{2}$  barren; Sikkim: not very common), which is adopted by Beddome as var.  $\zeta$  *semifertile*, is probably merely a local form of one of the soft Himalayan plants.

With var. 4 *mucronifolium* (sp.) Bl.,—Beddome's var.  $\lambda$  *mucronifolia* Bl.,—I need not concern myself, as it is not said to grow in North-Western India: nor, for the same reason, with Clarke's var. 5—Beddome's var.  $\eta$  —*bicristatum* (sp.) Bl. Clarke's var. 6, *setosa*, Wall. Cat. 371—Beddome's var.  $\theta$  *setosum*—I give below as a distinct species; and Beddome's vars.  $\iota$ , *anomalum* and  $\kappa$ , *Travancericum*, do not concern me as they have not been recorded from N. India. Other two plants given in the *Synopsis* as synonyms of *A. aculeatum*, namely, *A. luctuosum* Kze., and *A. Tsus-Simense* Hook., I shall give as good species under the first of these names.

Turning again to the three individual plants mentioned in the *Synopsis* as being varieties of the imaginary comprehensive species No. 18, *A. aculeatum*, I find some difficulty in ascertaining their distinguishing characters. Swartz's description is:—

“frondibus bipinnatis, pinnis pinnatis, pinnulis ovatis acutis sub-falcatis ciliato-spinosis, subtus pilosis, rachi paleacea, stipite strigoso, Smith britt.

*Polypodium aculeatum*, L.

*Polypodium setiferum*. Forsk fl. acg. ar.

Pluk. ph. t. 180. f. 1. 3, Moris. p. 14. t-3. f. 15.

(Schkuhr l. c. t. 39.—W. M.) Europa. Arabia, Cap. bon. spei.”

This shows clearly that the fern Swartz described had ciliate spines on the pinnules, and therefore was soft and not prickly; but the rest of the description is too vague, and the only substantial difference in his description of his *A. lobatum* is—“*pinnis approximatis*.” Swartz seems to have done little more than transfer Linnæus's plant from *Polypodium* to *Aspidium*; but Willdenow, only two years later, interpolated in Linnæus's list *A. angulare*, and from his descriptions of that and *A. aculeatum* it is clear that under the new name he recognised a fern with a more compound cutting and a laxer texture than he saw *A. aculeatum* had. He, however, gave only Hungaria as the habitat for *A. angulare*, whereas now it seems to be a very widely distributed species.

E. J. Lowe, in “British Ferns, 1891,” the latest authority I can find says:—“*A. aculeatum* Sw.—Pinnules stalklets, with acute angled or wedge-shaped bases; whilst in *A. angulare* the pinnules are stalked and their bases obtuse-angled. In *A. aculeatum* the fronds are darker and more shining, stouter and more leathery in texture, and the habit of the plant is more erect.” Mr. T. Moore, who considered them distinct species, said the chief differences between the two were—the obtuse angle of the stalked pinnule of *P. angulare*, and the acute-angled, or wedge-shaped base of the sessile pinnule of the more divided states of *P. aculeatum*. Mr. James Britten, in “European Ferns,” says:—“So far as our experience goes they are not often found together, but they contrast very effectively with each other when planted in a rockery, the stiff upright fronds of *P. aculeatum* towering above the softer and more drooping ones of *P. angulare*.” To a sheet in the Kew Herbarium (general collection) marked in Sir W. J. Hooker's handwriting—



"Ireland, D. Moore," and also, in pencil—" *A. Braunii*, intermediate between *aculeatum* and *angulare*," is pinned a note written by D. Moore, as follows :—

"After considerable attention to *Aspidium lobatum* and *A. aculeatum*, I cannot think them distinct species, though I find they are still retained as such by persons who have no doubt had equally good opportunities of judging. Consequently I shall only state my own ideas on the subject at present, when it appears to me they altogether depend on their places of growth for the slight characters which distinguish them. Whenever I find the species growing in warm shady situations, it assumes the habit of *aculeatum* by having the pinnule slightly petiolate and generally larger. A little further up the mountain glens it becomes *lobatum good*; and when it is found very high the pinnules are scarcely divided at all. *A. angulare* is equally common here" (in Ireland ?) "and a very distinct species. I should say there were only two species, *A. lobatum* or *aculeatum*, whichever you like to call it, and *A. angulare*, both rather variable, but their varieties are easily traced to the original."

I understand Mr. Baker now to agree, substantially, that *A. lobatum* is merely *A. aculeatum* in a less developed state; though in the "*Synopsis*" he said that the last mentioned plant is less coriaceous than is the other; and I therefore think I may safely allow the existence of *A. lobatum*, as an Indian fern, to depend upon the existence there of *A. aculeatum*.

Dr. H. Christ, in a monograph—" *Les différentes formes de Polystichum aculeatum* (L. sub. *Polypodio*), *Leur Groupement, et Leur Dispersion, y compris Les variétés Exotiques*, published in Bull. Bot. Soc. Suisses, Livre III, 1893, has taken quite as wide a view of this group of *Polystichum* as any of the botanists who have written of Indian ferns; but his treatment of the subject is too deductive for me; it seems only to deepen the haze in which the subject has been enveloped by the profitless effort to bring together under the specific name *aculeatum*, given by Linné, several plants which are abundantly distinct.

In proceeding to deal with the North-West Indian material of this group I shall, in the first place, divide it according to texture, into "coriaceous", hard and tough plants, and "herbaceous", thin and soft plants; and having thus cleared the way, I shall see whether any subdivision of these two categories is necessary. I can find nothing I feel justified in calling *A. aculeatum*, but much that I cannot say is not *A. angulare*.]

*A. Texture very coriaceous. Sp. II.*

11. *A. squarrosus* Don (*rufo-barbatum* Wall. Cat. 369); Syn. Fil 252, under *A. aculeatum* Sw. *A. aculeatum* Sw., var. 2, *rufo-barbatum* (sp.) Wall., C. R. 509. *Polystichum aculeatum* Sw., var. f *rufo-barbatum* Wall., Bedd. H. B. 207, F. S. I., t. 121.

I hazard the following as a new and complete description of this species :—

*Plants* isolated, or united in tufts. *St.* densely tufted, forming a thick rootstock, thickly covered at base with long linear bright chesnut scales from 1 and 2 in. l., gradually succeeded upwards by large broadly-ovate acuminate scales, with more or less broad dark-brown centres, the scales further up resuming the pale self-colour of those at base, and becoming mixed with the pale-coloured long and narrow scales or fibrillæ which in diminishing size clothe the main and partial rhachises and costa. *Fr.* lanceolate-acuminate, sometimes broadest near base, often 2 ft. l., rarely  $2\frac{1}{2}$  ft., by 3—9 ins. br.—average breadth perhaps 6 ins., always bipinnate : *pinn.* always broadest at base because auricled, very gradually narrowed to the quickly acuminate apex, always though shortly stalked, distant at base but becoming crowded and imbricated towards apex : *pinnl.* 12—18 pairs, all distinctly stalked except near apex of the frond, close and often overlapping each other at base ; *in simplest form*—rhomboidal with a curved apex or ovate-acuminate, entire and cut away towards the base on inferior side and always broadly auricled on superior side, sharply and stiffly toothed at apex of pinnule and auricle and hardly toothed elsewhere except obscurely on the superior side above the auricle, *in less simple forms* the pinnules prolonged and more or less lobed or pinnatifid with sharp stiff teeth on each lobe or segment on both sides, the lowest of all pinnatifid and sharply toothed ; up to  $1\frac{1}{4}$  in. long, and cut down nearly to the rhachis with several (up to five) pairs of narrow segments ; all lobes or segments furnished with hard sharp mucronate teeth, never merely aristate ; *Texture* very coriaceous, frond heavy ; upper surface glabrous and shiny ; lower—covered on veins with small pale-coloured fibrillæ and occasional shorter and broader minute scales : *colour* greyish green ; *ven.* obscure, best seen on underside : 4—6 groups on each side of the costa, pinnate or forked in the lobes, reaching almost to the margin ; *scri* large, crowded, and ultimately extending across several veinlets, absent from centre of pinnæ and apex of pinnule, but occasionally found on auricle ; *receptacle* consisting of numerous persistent fibres in a bunch ; *involucres* large, cucullate, persistent, stalked, with dark centres (the sporangia when ripe spreading widely beyond the edge), veins of involucres radiating and connected by scalariform veinlets.

Don's description, though perhaps fuller and better than those he wrote of some other species, seems either to have been thought insufficient or to have been disregarded by subsequent authors, which must be my excuse for writing a new one. I will, however, give extracts to show that it does not apply to

*A. aculeatum* Sw. He says—"6. *A. squarrosus*, fronde lanceolatâ bipinnatâ : foliolis pinnisque alternis subsessilibus oblongo-ovatis mucronatis rigidis glabris nitidisque." . . . "Polypodium spinulosum, Hamilton M. S., nec aliorum.

. . . "Frons ampla, rigida, tectu aspera." Don's fern was, therefore, bipinnate, mucronate, rigid, smooth and shining, but rough to the touch.

*Punjab* : Chamba—6000' McDonell; *Kangra Vy. Dist.*—Dharmasâla 6000', Trotter ; *Kullu* 6—8000', Coventry ; Mandi State 7000', Trotter ; *Simla Reg.* 5500'—8000', common, Hope, Gamble Blauf., Duthie, Bliss, Lacey.

*N.-W. P.* : *D. D. Dist.*—Jaunsar 5500' and upwards, Sundar Lâl, C. G. Rogers, Gammie ; Mussooree 5-6500', very common ; *T. Garh.* above Dhakara, Duthie's colln. 1879, Ganges Vy. 7-8000', and Phedi, Duthie ; *Kumaun*—common 5-8500', S. & W., Hope, Davidson, Trotter, Macleod.

*DISTRIB.*—*Asia* : N. Ind. (Him.)—Nepâl, Sikkim and Bhotân. Assam—Jakpho. Mt.; Kohima 6000', Clarke.

Occasionally the whole of the scales and fibrils or stipes and rhachis are brown and not rufous, faded perhaps. The cutting of the ultimate segments the coriaceous shiny nature of the frond, and the stiff mucronate spines sufficiently distinguish this species from the other Himalayan plants which have been called *A. aculeatum* and *A. angulare*. The plant produces numerous fronds annually, grows to large bushes, and is evergreen in spite of frost and snow in winter. Sori are generally wanting on the lower third or quarter of the frond, but often also on the upper part. The involucres sometimes overlap each other.

I cannot follow Clarke and Beddome, when they say—"frond usually reddish." The rhachises and costæ are covered below with the red beard from which Wallich named the plant ; but the small fibrils on the veins are not enough to colour the surface of the pinnules, and the upper surface is either quite glabrous, or has only a few fibrils on the costa.

I think what Clarke calls *A. aculeatum*, var. 1, *lobata* (sp.) Engl. Bot., must be the very narrow form of *A. squarrosus* of which I have specimens from the Simla Region, Jaunsar, and Tehri Garhwâl. The pinnules are small, simple, ogival at apex, very close together, and imbricated, and are less distinctly stalked than in the normal form—reduced to lobes in the upper part. The scales and fibrillæ are brown rather than rufous ; and the texture is rather thicker than in the type, and the fronds dry a brown colour. In all other respects the plant is identical with the present species, and is antithetical to the so-called *A. lobatum* of European botanists.

#### *B. Texture herbaceous.*

12. *A. angulare*, Willd. Sp. Pl. 1810 V. 257 ; "*Frondibus* bipinnatis, pinnulis oblongis subfalcatis mucronato-serratis sursum auriculatis, infima elongata subpinnatifida, stipite rachibusque paleaceis. *W. Habitat in Hungaria.*



"*Stipes* tri—vel quadripollicaris paleaceus. *Rachis* universalis atque partialis paleacea sed pales tenuiores. *Frondes* sesqui-vel bipedales bipinnatæ. *Pinnæ* tripollicares et longiores. *Pinnulæ* oblongo-subfalcatæ acutæ basi cuneatæ sursum acute auriculatæ, serratæ, serraturis mucronatis. *Pinnæ* infima superior reliquis longior pinnatifido-serrata. *Sori* subrotundi. Affine *A. aculeato* sed præter formam pinnularum præcipue *pinnula* infima pinnatifida et habitu laxiore diversum. W."

KASHMIR : *Chittapani* Vy. 8000', Trotter ; Dardpura 5-7000', and Aud'rbug 7000', MacLeod ; Pir Panjáb and Gulmarg 7000', Gammie 1891.

PUNJAB : *Hazara Dist.*—Black Mt., Kalim Gali 8000', Duthie 1888 ; near Kalapáni 6-7000', Trotter 1890.—*Chamba*—McDonell, comm. 1885 ; above Chamba town 7000', Blauf. 1886 ; *Kullu* 6-8000', Coventry 1894 ; *Simla Reg.*—Simla, eastward to Hatu Mt. 48-8300', Hope, Blauf., Bliss ; Bashahr Forest 8000', Lacey.

N.-W. P. : *D. D. Dist.*—Jaunsar 43-8000', Brandis, Duthie, C. G. Rogers, Gamble ; Mussooree 6500' and downwards, very common ; in the Dún (Valley)—Nalota Khála 2500' or more, Hope 1880 and 1891, some very large ; T. Garh.—Nila Vy. 11-12,000' ? Duthie 1883 ; Sahla Forest 7000', Deota 5000' and Bamsu 6000', Gamble 1893-95 ; *Kumaun*—near Karim 6200', and Naini Tal, S. and W. 1848, and Hope 1861 ; Ralam Valley 11-12,000', Duthie ; Lohughát 5000', Trotter ; Ramganga Vy. and elsewhere 5000', MacLeod.

DISTRIE.—*N. & Centr. Amer.* *Eur.* : common. *Asia* : near the Black Sea ; *N. Ind.*—Sikkim ; Assam—Khasia.

After having renewed acquaintance with the living European plant, and having gone through the specimens of it and from all habitats, in the Kew Herbarium, including the British collection of the late Mr. Thomas Moore which shows what a wonderfully variable species it is (without taking into account mere sports and abnormal developments), I find I cannot definitely separate from *A. angulare* any of the Himalayan material which has been placed under that species. But I will indicate where differences occur. In my own collection I have, from North-Western India, 32 sheets, on which are 36 specimens, some of which consist of 2, 3, and even more fronds, besides unmounted duplicates.

1. *As to scales.* Some of the Himalayan specimens have no broad ovate scales on the stipes—such as the European specimens all have : many instead are clothed near the base with long linear-acuminate scales, which pass into mere hairs higher up, and along the rhachis. These scales and hairs are generally dark-brown or nearly black, but occasionally they are of lighter, dull-brown colour. I have, however, seen hairs on a few British specimens. Some specimens have large, broad, ovate-acuminate, hair-pointed scales, mixed with narrow linear-acuminate scales, which become almost hairs on the rhachis : the broader scales are bi-coloured, but the very dark-brown colour of the centre seems to belong to the upper surface, and the under surface and narrow margins are



pale ; the narrower scales are also, sometimes at least, bi-coloured. The scales of the European plant, whether broad or narrow, are generally pale, self-coloured, or if bi-coloured merely with a darker shade towards the centre.

2. *Habit of plants.* The European plant has fronds with comparatively short stout stipes, thickly clothed with scales all the way up, forming a stout compact crown, from which very numerous fronds spread out at a greater or less angle from the perpendicular. The Himalayan plants appear to have comparatively few fronds, generally with long stipes which quickly taper off and are not densely clothed far above their bases ; but sometimes stipes are only 6 in. long to a frond 22—25 in. long by 9—10 in. broad. Growing on steep ground in forest, as they generally do, the fronds of the large plants (or of the large broad form), being of lax habit, bend downwards, and are sometimes found overhanging and dipping their tips into the rills which run down the rocky hill sides. The fronds vary much in size and shape, even in the same station. 5 ins. to 6 ins. is a common length for the middle pinnæ of a frond, and the lowest pinnæ are often not much reduced ; a lanceolate frond is rare, and then the lowest pinnæ are not mere auricles. I have the upper three-fourths or so of a frond I gathered in the Dehra Dún in 1880 (why now incomplete I cannot recollect) which has pinnæ fully 9 ins. long, and this portion of the frond is 23 ins. long. Fronds from Mussooree, 5-6000' alt., reach to 34 ins. in length by nearly 1 ft. in breadth, unstretched, beside stipes 13—15 ins. or 4 ft. in total height. But I have, also from Mussooree, other fronds of mature plants, fertile, with simpler cutting, which are less than 1 ft. high, including the stipes, by only 3 ins. broad. All sizes between these extremes are met with. The British plant rarely, I think, has fronds over 6 ins. broad. The latest specimen, from Jaunsar, the hill tract of the Dehra Dún district, is Gamble's No. 26616, April 1898 : a frond and incomplete stipe, the frond 38 in. by 26 in., and part of stipe 21 in., total over 5 ft. high. The pinnules have up to ten lobes. The plant is very soft. Dr. Christ says this is *var. batjanense* of *A. aculeatum*, Filicine Warburg, Monsunia, Bd. I, p. 77.

3. *Cutting of fronds and pinnæ.* The pinnæ are always distant, or distinctly separated ; and the pinnules so also, and distinctly stalked. In the large, broad, form the pinnæ are very acuminate, and even caudate ; but in the smaller they taper regularly from base to tip, as in the European plant. The pinnules vary in shape from—"short ovate-acuminate with a broad auricle,  $\frac{5}{8}$  in. long to  $\frac{1}{8}$  in. broad, lobed on the front and toothed on the back," to—"falcate,  $\frac{5}{8}$  in. long by  $\frac{3}{8}$  in. broad, lobed though unequally on both sides," and to "narrow, falcate, acuminate,  $\frac{3}{4}$  in. long, by only  $\frac{1}{8}$  in. broad at base across the auricle." I have never seen the auricle free ; and the longest pinnules are seldom cut down nearly to the costa ; whereas the European plant is

sometimes tripinnate at base of pinnules. There seems to be an aristate tooth, or awn, to each veinlet; but the awns are never so long as in the European plant, and they therefore seem stiffer; they are, however, really soft.

13. *A. luctuosum*, G. Kunze in Linnea, Vol. 10. (1835-36) p. 548; "† 103. *A. luctuosum*, Kze.: *costis* rhachibus stipiteque fronde breviori nigriscenti-paleaceis; *fronde* lanceolato-acuminatâ, bipinnatâ, coriaceâ, *pinnis* alternis, petiolatis, longe attenuatis, sursum auriculatis; *pinnulis* trapezio-ovatis, subfalcatis, mucronatis, basi sursum auriculatis, deorsum truncata cuneata decurrentibus, aristato-serratis; *indusius* reniformibus glabris."

*A. aculeatum*, Sw., Syn. Fil. 252; *A. Tsus-Simense*, Hook., Sp. Fil. IV. 16, t. CCXX.

KASHMIR: Jhelam Valley 3500'; Chitapani Valley 75-8000', Trotter 1888-89; Jhelam Valley, 5 miles from Râmpur 4500', MacLeod 1891; Upper Chenab Valley, 6500', McDonell 1893.

PUNJAB: Hazara Dist.—Trotter in MS. List of Punjab Ferns. *Chamba*.—Ravi Valley, Chanju 7000', and near Tisa 7000', McDonell 1882.

DISTRIB.—*N. Amer.*—California. *Asia*: N. Ind. Assam—Mausmai, Griffith, 1885; Khasia—Cherra, Hk. & Th.—Japan—Island of Tsus Sima, in Straits of Corea, Wilford; Yokohama, Dickens.

On seeing Mr. McDonell's Chamba specimens I thought them quite different from *A. aculeatum*; but it was not until many years later that I found them to be identical with a specimen from Natal, collected by Buchanan, which is ticketed *P. luctuosum*, Kze. Then I had the privilege of a perusal of Dr. Christ's monograph on *Polystichum aculeatum*; and I also saw McDonell's later collected specimens from Kashmir which were ticketed *A. Tsus-Simense*, and I wrote to him on the subject. He replied that he had got the name from Colonel Beddome, who, on seeing those and other specimens of Mr. McDonell's Kashmir collections, wrote as follows:—"Aspidium—Upper Chenab Vy., = *A. Tsus-Simense*, Hook.; figured and described by Hooker in Sp. Fil., included by Baker in Syn. Fil. under *aculeatum*. I call it *Polystichum aculeatum*, var. *Tsus-Simense*; it exactly corresponds with the Japanese specimens. New to British India." (Now, I rather think Mr. McDonell referred to Colonel Beddome after I had called his attention to the plant.)

On revisiting Kew I have seen that on the cover which contains many China and Japan specimens of *A. Tsus-Simense* Sir W. J. Hooker wrote in pencil—"20. *Tsus-Simense* est *luctuosum*, Kze., not Pappé." In the Synopsis both these names are given as synonyms of *A. aculeatum*, Sw., though in the Sp. Fil. Vol. IV., p. 16, *A. Tsus-Simense* is given as A. No. 20, and figured as such on Plate CCXX. On the Herbarium working Copy of the Sp. Fil. Sir William Hooker has written—"If the same as *luctuosum*, Kze., I fear it is too near *aculeatum*." On p. 19., under *A. aculeatum*, Sir William wrote, in ink,

"*an P. luctuosum*, Kze.," ; and, again, "*luctuosum*, Kze. is the same as my No. 20 A. Tsus-Simense, v. n. 20."

Christ places *A. luctuosum* as a var. of 6. *P. lobatum*, and says of it :—

"Distinct, from its deltoid form, not elongated, and with a frond the lowest pinnæ of which are the longest. The frond is borne on a bare stipe, of one-third to one-half the length of the frond. Throughout (*en outre*) the scaly covering of the rachis consists of black, long, and very narrow scales. The basal scales are narrow, blackish. The plant is of less height (*plus basse*), the pinnæ (pinnules ?) are slightly auricled, subsessile, decurrent (except the superior basal pinnule which is broadly stalked), stoutly toothed, but not aristate.

"Kunze's name, relating as it does to the black covering of the plant, very well indicates its peculiarity.

"*Habitat*.—Southern Africa ; Boschberg, (McOwan), Drakenberg (Rehman, 7204)."

Hooker's description of *A. (Polyst.) Tsus-Simense* is long and minute. As to *Habitat* he gives only the Island of Tsus Sima ; and he adds—"I find no described species to accord with this. The scales of the caudex are singular in shape and peculiarly black ; the upper portion of the frond is pinnated, the rest regularly bipinnate, the lowest pair of pinnæ deflexed." In the Kew Herbarium, on the same sheet with Dickins' specimen from Yokohama, is a larger frond with ticket—" *Polystichum luctuosum*, Perie Bush, British Kaffraria, May 7th, 1861, W. D'Urban." Opposite this Sir William Hooker has written in pencil—"black hairs on the rachis—hence true *luctuosum* of Kze., in Linn. 10 p." Another sheet from South Africa (a plant with caudex and four fronds in a tuft) has two tickets, one written by Baker (?)—" *Aspidium luctuosum*, Kze., No. 11, Natal, Buchanan ; and the other, Buchanan's own ticket, is (read. 8/69) "11. A very fair specimen—natural colour well preserved" (it is pale olive green) : "Grows in same bush and similar places with *Aspid. aculeatum*, of which 11a is our ordinary type, only not at all so plentifully. If only a variety, it is a very marked one. But is it indeed so ?"

14. *A. setosum*, Wall. Cat. 371. *A. aculeatum*, Sw. var. 6, *setosum*, Wall. Cat. 371, C. R. 510. *Polystichum aculeatum*, Sw. var. 9 *setosum*, Wall., Bedd. H. B. 209.

N.-W. P.: *Brit. and T. Garhwal*—8000', P. W. Mackinnon, April 1881 ; *Kumaun*—R. Blink, *vide* Wallich, in Herb. Hort. Kew ; near Khāti 7700', S. & W. 1848 ; Pindar Gorge—Khāti 7000', Trotter 1891.

DISTRIB.—*Asia* : N. Ind. (Him.)—Nepal, *Wallich* 1820 ; Sikkim.

This plant is not mentioned by Baker, either in the "*Synopsis*," or in his "Summary of New Ferns." Clarke, while giving it as a mere variety of *A. aculeatum*, says :—

"This seems to me more worthy of specific rank than many other species of *Polystichum* retained by Mr. Baker. The series is not merely defined by being fibrillose on the surface of the frond beneath ; the whole set is remarkably uniform in cutting ; the frond is large, long-lanceolate ; the primary pinnæ numerous,



close together, nearly parallel to each other; the secondary pinnæ numerous, close, very distinct, all remarkably like each other. Nor are there any connecting forms between the var. and any other form of *A. aculeatum*."

Beddome's description is:—

"Lower surface of frond with very fine fibrillæ, rhachis with very long scales as well as fibrillæ, pinnules small, quite entire, except the spinulose apex, or with very inconspicuous crenatures to represent the usual lobes; sori apical, on the lower veinlet of the forked or pinnate vein of the segment (or what would correspond to the segment where the pinnule is entire)."

Christ puts this fern as—4. *P. lobatum*, var. *setosum*, Wall., and says of it:—

"This plant is very remarkable for its scaly clothing; not only is the rhachis clothed with enormous principal scales, yellowish and pellucid, oval or round, which even attain in the upper part of the frond the length and breadth of 8 millimètres or more, but all the parts, with the pinnules, are upon the two faces covered with numerous thread-like scales (hairs), which are flexible" (wavy?), "one centimètre long, and golden in colour, which gives to this magnificent plant a very rich appearance. The frond is of the largest size (70 centimètres), the pinnules numerous (up to 80 in one pinna), lanceolate, toothed (?) like a comb, decurrent, scarcely stalked, almost toothless, only the lowest of the upper row, which is much larger than the rest, being deeply cut. The texture is flaccid, membranous."

"*Habitat*.—Excessively damp forests of Sikkim, Himalaya on Senchul 8000' (Gamble 8041) and 9000' (Gammie)."

Both Clarke and Beddome say that only the lower surface of the frond is clothed with long fibrillæ. Christ is right in saying that both surfaces are so clothed. I have not seen this fern growing; but, judging from herbarium specimens, it seems quite distinct from any other species of the group. A specimen collected in Sikkim, alt. 5000', by Sir J. D. Hooker, has, besides the long straw-coloured hairs, large ovate-acuminate dark-brown scales all along the main rhachis. Some other specimens have similar scales, but pale-brown in colour. A specimen from Wallich, in *Herb. Bentham* at Kew, has very large broad scales up the stipe, brown with darker centres.

15. *A. Prescottianum*, Hook. Sp. 4. p. 22., t. 223; Syn. Fil. 253: C. R. 510. *Polystichum Prescottianum*, Wall., Bedd. H. B. 210.

AFGHAN.: Kuram Vy.—9-10,000', Aitch. 1879.

KASHMIR: *Gilgit*—Sai, Col. Tanner; Gulmarg 10,000', Lev.; Pir Panjál 11,500', Trotter, Gammie; Sangam Valley, 13-14,000', Duthie 1893, No. 13539.

PUNJAB: *Hazāra*—Khágán Valley 9000', Dr. Stewart: *Chamba*—Sach and Drati Passes 10-12,000', Baden-Powell 1879; Ravi Valley.—Satrundi and above it 11-12,000', and Cheni Pass 12,000', McDonell; *Kullu*—Rohtang Pass 13,000', and Jalori Pass, N. 10,000', Trotter; *Lahoul*—Chandra Valley, 11,000', Trotter; *Simla Reg.*—Jubal State, Chor. Mt., Collett; Sirmur State 9-10,000'. T. T.; Hatu Mt. 9.5-10,500', Edgew, Bates, Collett, Gamble, Blauf., Hope, Trotter, Bliss; *Bashahr*—near Hárang Pass 12,500', Lace.



N.-W. P.: *D. D. Dist.*—Jaunsar; Chachpur Peak 10,000', Gamble 1892, Keràna 9500', Gamble 1893 (on sheet with *A. Thomsoni*); *T. Garh.*—10-16,000' (ten stations) Duthie 1879—83; *Brit. Garh.*—Dombitla Gadh 9-10,000', Duthie 1885; *Kumaun*—Wallich; above Tola 12,500' and near Milam, S. & W.; Palam Vy. 11-13,000', S. & W., Trotter; Pinsara 10,000', Davidson; Dhauli Valley 14-15,000', Duthie 1884; near Pindari Glacier 10-11,000', Trotter 1891.

NEPAL, W.—Nampa Gád, 12-13,000', Duthie 1886.

DISTRIB.—*Asia*: N. Ind. (Him.)—Nepal; Sikkim and Bhotán.

Clarke's and Beddome's descriptions of *A. Prescottianum* are better than that in the *Synopsis* in that they mention the fibrillæ or narrow scales which are mixed with the large broadly ovate-acuminate scales on the stipes and rhachis. On the rhachis the scales get narrow and smaller, and the fibrillæ more hair-like. The fibrillæ are found on the surfaces, perhaps more sparingly on the upper than on the lower. The cutting of the frond varies of course with the size; but, with the exception mentioned below, I cannot find any specimens on which the pinnae are "even pinnate," as Beddome says they are; and yet I have fronds, gathered by myself on Hatu (or Hatugarh) Mt., which are up to 27 ins. long by 4 ins. broad, though 18 by 3 ins. are the maximum dimensions given in the *Synopsis*. The habit of the plant is well described by Blanford—"abundant on Hatu, growing in dense masses, on the hill side between 9,500 and 10,500 ft."—in the open, chiefly, I should add. The rhachis may be weak, as the *Synopsis* says; but the masses on Hatu Mt. Blanford speaks of (as I have seen) are composed of stout upstanding plants; the fronds support each other, perhaps. Normal fronds of old plants have from 35 to 40 pairs of pinnae—generally about 40—cut down to a winged rhachis into 8—10 pairs of elongated rhomboidal segments which have 4 or 5 pairs of aristately toothed lobes. Beddome's figure is from a young plant, and does not correspond with his description.

I have a beautiful little frond from Kashmir, Duthie's No. 13539 above-mentioned, stipe (incomplete) about 3 inches, frond 10 in. long by 2 in. broad, unextended, bipinnate, pinnules stalked, distant, rather bluntly and shallowly lobed or toothed, scales and fibrillæ as of *P. Prescottianum*, with numerous pinnae of which most are again pinnate. Small as it is, it is mature and crowded with sori; and had I more material like this I should be inclined to make of it a separate species, from the distinct bipinnateness, the great breadth of frond in proportion to length, and other characters.

Another form, notably different from the type, is that of Duthie's specimens Nos. 2215, 5159, and 6240, from Tehri Garhwál, British Garhwál, and West Nepal, which has stipes up to 10 or 11 inches in length, very regularly shaped ovate-lanceolate bipinnate fronds 15—18 ins. long by 4—5 ins. broad; pinnae distant, about 30 pairs below the pinnatifid apex of the frond, pinnules

broad, falcate, sometimes auricled, aristately toothed, decurrent below and not stalked, lowest upper the largest, about 15 pairs besides an acuminate pinnatifid apex. The scales and fibrillæ are those of *P. Prescottianum*. This is a remarkably elegant and graceful fern.

16. **A. Bakerianum**, Atkinson MS.; Baker in Hook. Ic., t. 1656; Clarke and Baker in Journ. Linn. Soc. XXIV., 414. *A. Prescottianum*, Wall., var. *Bakeriana* (sp.) W. S. Atkinson MS., C. R. 510. Pl. 66. *Polystichum Prescottianum*, var.  $\beta$  *Bakeriana* (Clarke) Bedd. H. B. 210.

KASHMIR: Marbul Pass 11,000', and Sind Valley 12,000', Clarke 1876; Pir Panjal 11,500', Trotter 1888; Sarpat 10,000', McDonell, MacLeod 1891.

PUNJAB: *Chamba*—Ravi Valley, below Cheni Pass, 10,000', McDonell 1882, 1885; *Kangra Vy.*, near Dharmasala 11,000', C. B. Clarke 1874; *Kullu*—Seoraj, Trotter 1887; *Simla Reg.*—Chor Mt., Herschel 1877 (*Nephrodium Brunonianum* on ticket) Jalaury Pass, Edgew.; Kunáwar 11,000', T. T. 1847.

N.-W. P.: *T. Garh.*—Kidár Kánta Mt. 9000', Herschel 1879; Damdar Valley 9-10,000', Duthie 1883; *Kumaun*—Kaphini 10,000', "grown at Almora", S. and W.; Pinda, Gorge, and Dwali to Phurka 9000', Trotter 1891; Gori Ganga Valley, 10,500', MacLeod 1893.

DISTRIB.—Asia: N. Ind. (Him.)—Sikkim.

Clarke (whom following Beddome) says—"frond truncate at the base;" but I find that all the fronds Gamble and I have are tapering, and even dwindling downwards to auricles. This species seems glabrous on the upper surface: *A. Prescottianum* is slightly fibrillose. The sori sometimes look nephroid.

#### SUBGENUS CYRTOMIUM, PRESL

17. **A. falcatum**, Sw., Syn. Fil. 257; C. R. 512. *Cyrtomium falcatum*, Sw., var.  $\beta$ . *Caryotideum*, Wall., Bedd. H. B. 211, F. S. I., t. 119.

KASHMIR: Jhelam Valley 3500', Trotter 1888; Jhelam Vy.—Chakoti, Kishenganga Valley, and Titwal, MacLeod 1891.

PUNJAB.—*Hazara*—*vide* Trotter: "cut from a plant in pot, at Abbotabad, in possession of Major Dempster, 4th Sikhs, who said it had been transplanted from near Natiagali 7000', where it grew in quantity; *Chamba*—McDonell (*vide* Trotter in List); *Kullu* 55-8000', Trotter, and Coventry; *Simla Reg.*—Bates; below Simla to north 4500', Gamble; "very rare. The one or two localities are rocky ravines between 5 and 6500', 'Blanf. in List.

N.-W. P.: *D. D. Dist.*—Jaunsar; Deoban, Vicary 1838, in Herb. Sahar; 7000', Brandis 1881; Missan 7000', Gamble; Mussooree, T. T. 1845, Dr. G. King 1871?; Duthie 1877; 5000', Mackinnons 1878; 5500', Hope 1881 and 1887; 5000' J. W. Furrell 1895. *T. Garh.*—Ganges Vy., between Betwari and Dangulla, and Kidár Kánta Mt., Duthie 1881; *Kumaun*—T. T. 1845; Dwali 8260 and near Khati 7800, S. & W.; Hope 1861, Davidson 1875; Pindar Gorge, Trotter 1891; Gori Valley.—Buin 3000', MacLeod 1893.

DISTRIB.—Asia: Ind. Or.—(Him.) Sikkim and Bhotán, 3-8000'; Assam—Khasia 3-4000', not common. S. Ind.—Nilgiris, at the higher elevations. Japan. China. Sandwich Islands. *S. Afr.*—Caffraria, Natal, Madagascar.

The *Synopsis* gives  $\varepsilon$  *A. caryotideum*, Wall., but adds—"It is impossible to separate our two varieties satisfactorily." Clarke gives *A. caryotideum* as a synonym. Beddome does not give *A. falcatum* as an Indian plant, and says it differs only slightly from *B. caryotideum*. The N.-W. Indian plant seems to be the latter, which is very commonly cultivated in Great Britain. It loves water and shade—in the Himalaya. Mr. Clarke's No. 17656, from Assam, Khasi Hills, has very long, narrow, falcate and toothed pinnae, 7 ins.  $\times$   $\frac{3}{4}$  in. : one frond has pinnae 5 in. long, by only 1 in. broad.





## THE FERNS OF NORTH-WESTERN INDIA.

Including AFGHANISTAN, the TRANS-INDUS PROTECTED STATES, and KASHMIR: arranged and named on the basis of Hooker and Baker's *Synopsis Filicum*, and other works, with New Species added.

By C. W. HOPE.

(Continued from page 480 of this Volume.)

### PART III.—THE GENERAL LIST.—(continued.)

Genus 23. NEPHRODIUM, Rich.

Subgenus LASTREA, Presl.

1. *N. aristatum*, Sw. (under *Aspidium*) ; *Aspidium* (*Polystichum*) *aristatum*, Sw., Syn. Fil. 255 and 493 ; Cl. Rev. 511. *Lastrea aristata*, Sw. (under *Aspidium*), Bedd. H. B. 229.

KASHMIR : *var. affinis*, Wall. Cat. 370, Trotter in List : "collected in two places."

PUNJAB : *Chamba*—Sach Nála 3-3500', McDonell, Bukam Nála 3500', McDonel, 1885, in Herb. Levinge.

N.-W. P. : *Kumaun*—*fide* Hooker on sheet in Herb. Kew, without ticket ; no rhizome.

DISTRIB.—*Asia* : N. Ind. (Him.), Nepál, *Winterbottom* ; Sikkim and Bhotan 4-10,000' ; Assam—Khasi Hills 3-6000', very common. Burms. S. India—very general in forests of Madras Presy. Malay Penins. and Isles. China. Japan. Philippines. Polynesia. Australia. S. Afr. : Natal.

I do not recollect seeing Trotter's specimens from Kashmir ; but I assume that they are the same as McDonell's specimens from Chamba, which seem to be quite typical *aristatum*, though there is no rhizome. In his Supplement of 1892, Colonel Beddome says of *Lastrea affinis* :—"A very variable species and the caudex is sometimes creeping and sometimes erect ;" but I maintain that this is a physical impossibility, and that such a difference of caudex constitutes a specific difference.

*Aspidium assamicum* (sp.), Kuhn in Linnea, XXXVI, 108, from Sikkim and Assam (*fide* Clarke), seems to be very distinct. On specimens of this in Herb. Kew is found the abnormal growth mentioned under *Pteris quadriaurita*, Retz., as being due to the fungus *Taphrina cornu-cervi*, Giesh.

2. *N. conifolium*, Wall. Cat. 341 (under *Aspidium*). *Aspidium aristatum*, Sw. var.  $\beta$  *conifolium*, Wall., Syn. Fil. 255. *Aspidium aristatum*, Sw., C. R. 511. *Lastrea conifolia*, Wall. (under *Aspidium*), Bedd. H. B. 230.

N.-W. P. : Kumaun, R. Blinkworth : *fide* Wallich in Cat.

DISTRIB.—*Asia* : N. Ind. (Him.), Bhotan ; Assam—Khasi and Garo Hills Burma—Tonghoo, *Parish*. S. Ind. : on the Western Mts. Ceylon. Malaya. China—Yunnan, *Hancock* 1894.

The type sheets in Kew are the only specimens I can find to vouch for the entry of Kumaun as a habitat for this fern. Wallich's entry in the Catalogue is :—"341 *Aspidium conifolium*, Wall. in Herb. 1823.

1. Napalia 20.,
2. Kumaun R. B.,
3. I. Neelghiry, Notan 1826, "

and a cutting from the Catalogue is posted on the sheet, on which also is a note by Sir William Hooker,—"E. I. C.—*Aspidium aristatum*, Sw., Wallich, *var. conifolia*." And there are several other sheets, agreeing, so marked by Mr. Bentham. These sheets are all the very finely cut decomposed fern which is got eastward along the Himalaya, and in Assam and Burma, and in Southern India, and which seems to me a very distinct plant from *N. aristatum*. The softer texture seems a distinctive character. In the *Synopsis Filicum* it is said :—"Dr. Thwaites assigns to  $\beta$  an erect caudex, and regards it as a good species." The late Mr. George Wall, in his Catalogue of Ceylon Ferns, Notes, p. 5, says :—" *Aspidium (Polystichum) conifolium*, Wall., having an erect caudex, seems specifically distinct from *A. aristatum*, a smaller plant with a creeping rhizome."

This and the preceding species are among those on the border line between *Polystichum* and *Lastrea*, which Beddome has removed to the last-named genus. Though they are the most compound of the Asiatic *Polystichums*, Colonel Beddome has, therefore, placed them at the head of the list of *Lastreas*, before the simply pinnate species, and made them a separate section—" *Indusium reniform* or orbicular, texture more or less coriaceous." Under *Aspidium sikkimense*, Baker, = *Nephrodium Sikkimense*, C. B. Clarke, Mr. Baker, in his Summary of New Ferns, of 1891, says :—"Like *A. varium* this stands on the line between *Aspidium* and *Nephrodium*, which I should not in a new book keep up as genera," i.e., I understand, as separate genera. Colonel Beddome, in F. B. I., t. 127, treated this fern as a *Polystichum*, and Mr. Clarke said Mr. Baker preferred Beddome's picture of the involucre to the specimens when he referred the species to *Aspidium*. In his Handbook, Colonel Beddome gave *Lastrea Sikkimense* (Bedd. under *Polystichum*), and said the involucre was reniform.

3. *N. hirtipes*, Hook. ; Syn. Fil. 26 ; C. R. 513. *Lastrea hirtipes*, Bl. (under *Aspidium*), Bedd. H. B. 232 = *Aspidium atratum*, Wall. Cat. 380, in part.

KASHMIR : Ghantamula—Tangdar Forest, 5300', McDonell 1891.

PUNJAB : Chamba, McDonell ; Simla Region—Raiengarh Forest 65-7000', Gamble 1898.

N.-W. P. : D. D. Dist.—Jaunsar, Cháchpur 7000', Gamble 1892, Cháchpur Valley 6000', Duthie 1898 ; T. Garh, 9000' ; B. Garh, 6-7000', P. W. Mackinnon 1881.

DISTRIB.—*N. Amer.*: W. Indies—St. Vincent *H. G. Smith*, No. 789 (in Herb. Sahar.). *Asia*: N. Ind. (Him.), Nepál, *Wallich*; Sikkim and Bhotan, common: Assam—Khasia, 4-6000', common, Kohima and Jakpho, 65-7000', *C. B. Clarke*. Manipur—Keyang, 8000', *Dr. G. Watt*. S. Ind.—Nilgiris, &c. Ceylon. Burma. Malaya. China—Yunnan, *Henry* 1898. Polynesia.

McDonell's specimen from Chamba (which I do not possess) has about 21 pairs of distinct pinnæ, cut down  $\frac{1}{4}$ — $\frac{1}{3}$  to the rhachis; pale brown scales on undeveloped fronds and base of stipes of old ones; traces of shed, blackish hair-like, scales on rhachis; mere traces of involucre; pinnæ hardly enlarged at base. Gamble's plant from Jaunsar has about 20 pairs of pinnæ enlarged at base by longer, rounded, lobes on both sides. Other specimens I have had from 20 down to only 10 or 11 pairs of pinuæ besides the suddenly narrowed pinnatifid apex. A specimen from Dárjiling, which Mr. Levinge marked as being typical, has stipes 12½ in., frond 15 in. by 10 in., with only 13 pairs of pinnæ which are nearly 1 in. broad. The number of sori on a group of veins (or segment) varies in this specimen from 1 pair, near the apex of a pinna, to 7, or even 9 pairs, about the middle. Five pairs seem about the maximum on the narrower pinnæ of other specimens.

*Nephrodium hirtipes*, Hook., is *Aspidium hirtipes*, Blume, Enum. Pl. Jav., Fil. 148; and it is said also to be *Aspidium atratum*, Wall., Cat. 380; but I find that of three sheets in the Wallichian collection, in the Linnean Society's Herbarium, one (named *A. atratum* by Wallich himself) is *N. parallelogrammum*, Kze. (*N. patentissimum*, Wall.), and so is another—not named *atratum* by Wallich. The third sheet, named by Wallich "*Aspidium atratum*, Napalia 1821," is *N. hirtipes*: the specimen is 16 in. broad, but it is incomplete: one-fourth or one-third of the frond is missing; there are 12 pairs of pinnæ—up to 1 in. br., cut down  $\frac{1}{4}$ th, more or less: veins 4-5 pairs in a group; segments with a beak; scales long, narrowing upwards, very dark brown, to black high up. The veinlets in *N. hirtipes* are all simple and stop short of the margin: those in *N. parallelogrammum* are all forked, and they project beyond the margin, forming small teeth; and the segments are not "beaked." In the British Museum Herbarium there are many specimens of *N. hirtipes* named *A. atratum* (by Wallich himself?): none of these are from the westward of Nepál; and none, I think, are *N. Gamblei*, my next species.

4. *N. Gamblei*, n. sp.—Plate VII. (See Part II., p. 533.)

5. *N. gracilescens* Hook.; Syn. Fil. 262; C. R. 513; Bedd. H. B. 234.

N.-W. P.: 7. *Garh.*—Phedi, E. of Landour, 4-5000', Duthie 1881.

DISTRIB.—*Asia*: (Him.), Nepál and Sikkim 6-8000', "not common," *C. B. Clarke*; Assam—Griffith? Khasia 4000', plentiful, *C. B. Clarke*. S. Ind.—*vide* Clarke and Beddome, Ceylon, Java, China, Japan.



I have two plants of this from Mr. Duthie, one without a ticket, but both are, I believe, from the Tehri Garhwál locality. Both are sterile. They are tufts, on an apparently erect caudex. The stipes are glabrous; and the veins are distant and simple. Some stipes are longer than the fronds. Clarke makes three varieties besides the type: the Garhwál plant may be his *var. decipiens*, which Beddome, in his Hand-book, thought might be a distinct species, but, in the Supplement to that work, retained as a variety. In their "Supplementary Note on the Ferns of Northern India," read before the Linnean Society 3rd November 1881, (Journ. Linn. Soc. XXV.) will be found descriptions of five varieties or forms, (including the type?) of this species, introduced thus:—

"Varietates et formæ a C. B. Clarke sub unica specie enumeratæ, ex sententia Beddome 2, vel 3, ex sententia Bakeri 3 vel plures species bonas constituunt: sed species a Baker propositæ cum species Beddomei non conterminæ sunt. Sequitur enumeratio formarum—" for which I must refer to the paper itself. In his "Summary of New Ferns" of 1891 Mr. Baker does not allude to this joint paper, but merely says that Mr. Clarke in his original paper of 1880 describes three Himalayan varieties. And Beddome, in his Supplement of 1882, refers to Clarke and Baker's joint paper only by implication, gives two varieties besides the type, and separates another as a distinct species. I have not seen this fern, or any of its varieties growing; and as none of these authorities has given a habitat for any of them west of Nepál, I might say no more than that the fern I give here is quite distinct from any other on my list, and that it is new to N.-W. India. In this, as in many other cases, I consider the mode of veneration all important; and—notwithstanding the statement in the *Synopsis Filicum*—I find that in all the specimens named *N. gracilescens*, Hook., and *var. decipiens*, this seems to be the same, namely—rhizome decumbent or horizontal, slow-growing, throwing up fronds in tufts, and dying off behind, probably annually. *A. glanduliferum*, Kze., is undoubtedly a distinct species, for it has a widely creeping and branching, slender, rhizome, which I should think must continue to throw up fronds at intervals (of distance) for a whole growing season at least, and in a moist climate, probably without cessation, though the hinder part must also continually be perishing. Mr. Clarke called this fern *N. repentulum* n. sp., until he found that it had already been named and described.

6. *N. calcaratum*, Hook.; Syn. Fil. 274. *Aspidium calcaratum* Bl. En. Fil. Jav., p. 159.

N.-W. P.: *Brit. Garh.*: Bhainskil, near Parewa, Kotal Range, about 3000', Coll. Ináyat (native collector), June 1902, No. 26043 of Saharanpur Herbarium; *N. Oudh*, Forests, R. Thompson 1870.

DISTRIB.—*N. India* to Ceylon, Burma, Hong Kong, Philippines, Malaccas.



Mr. Thompson's specimen in Kew was named *N. calcaratum*, Hook., by Mr. Baker, but Mr. Clarke afterwards marked it "typical *falcilobum*," which Mr. Baker gives as a synonym of *calcaratum*. The plant recently found in Garhwal agrees fairly well with the description in the "Synopsis," which is as follows :—

"*St.* densely tufted, stramineous, villose above ; *fr.* 1 ft. l., 3—6 in. br. ; *pinnæ* spreading, 2-4 in. l.,  $\frac{3}{8}$ — $\frac{3}{4}$  in. br., cut down two-thirds or more to the rhachis into oblique, subfalcate, linear-oblong, acute or blunt lobes ; *colour* dark-green ; *rhachis* villose ; *texture* villose or subcoriaceous ; *under side* more or less villose ; *veinlets* 3-6 on each side ; *sori* medial ; *invol.* glabrous, persistent. Hk. Sp. 4, p. 98. *N. falcilobum*, Hk. Sp. 4, p. 108.

Mr. Clarke does not give *N. calcaratum* as a species, but instead sets up *N. ciliatum*, C. B. Clarke (*Aspidium ciliatum*, Wall. Cat. 351) = *N. sericeum*, J. Scott, Syn. Fil. p. 494 ; and he also gives, as a separate species, *N. falcilobum*, Hook., which he says differs from *N. (Lastrea) calcarata*, Bedd. F. S. I., t. 246, and from Blume's Javan *Asp. calcaratum*, in the auricled stipe, the cutting, the venation, the sori, and the involucre*s*—i.e., in almost every particular, and—it might be added, in the colour, which in *N. falcilobum* seems to be pale green.

[No fern corresponding to *N. prezilum*, Baker, with erect caudex, tufted stipes, prominent glands at base of pinnæ, and lower pinnæ gradually reduced, is found in N.-W. India, so far as I know. The specimens in herbaria so named as having been found in that region all belong to the next two species, Nos. 7 and 8.]

7. *N. repens*, n. sp.—Hope Plate VIII. (see Part II., Vol. XII., No. 3, p. 535).

Add, under DISTRIB.—Assam—Shillong, C. B. Clarke No. 44652, 5—1887. Chain—Yunnan A. Henry 10094, presented to Kew 1900.

8. *N. xyloides*, Kunze in Linnæa, XXIV. 281 (under *Aspidium*) ; *N. prolixum*, Baker,  $\beta$ , *N. tylodes*, Kze. (under *Aspidium*), Syn. Fil. 268 ; *N. prolixum*, Hk. and Bk., C. R. 516. *Lastrea ochthodes*, Kze., var.  $\beta$  *tylodes*. Kze. (under *Aspidium*), Bedd. H. B. 240.

PUNJAB : Mandi State, near Dehlu, 5000', Trotter.

N.-W. P. : D. D. Dist.—Ridge west of Mussooree 5000', Mackinnons 1878-79. T. Garh.—Mantargádh 6000', Gamble 1898 ; B. Garh., Mrs. Fisher ; *Kumawn*—near Naini Tal, Wigram Money, Hope 1861 ; Almora 5500', Trotter 1891 ; Kot-Ganti Ridge 6500', MacLeod 1893.

DISTRIB.—Asia : N. Ind. (Him.). Sikkim, Livinge 1871. S. Ind.—Mts., rare Ceylon.

Kunze named his plant *xyloides* ; but in the "Linnæa" two pages further

on, he referred to it as *A. tylodes*, and subsequent authors perpetuated the mistake. Moore, in the unpublished MS. of his *Index Filicum*, noted the mistake—as Mr. Baker has shown me.

Kunze's long description of *Aspidium xylodes* shows clearly that it is the comparatively rare Indian plant, with sori close to the costa. The rhizome was unknown to him, and he had not seen a complete stipes. He calls attention to the "callus" at the base of the pinna, which is much longer than the "gland" in *N. ochthodes*. He says of this callus—"adhuc sæpe neglecto, insignem . . . Hinc ultimo proxime affino nostrum differt : fronde firmiore, supra nitida est, excepta costa supra, glabra, basi abrupte contracta ; soris non conjunctis, nec margine approximatis, ad costam productis, indusiis magnis, glabris, venis omnibus apice incrassatis, rhachi subtus stipitisque glabriusculis seu glabris." The gland or callosity is not visible on the upper aspect of the frond, and the pinna appears to be attached to both it and the rhachis of the frond. That the "callus" is remarkable, as Kunze said, is shown by the fact that in some specimens it is all that—below the perhaps single pair of leafy auricles—is left down nearly to the caudex to represent pinnæ. In other specimens there is just the merest trace of lamina besides the "callus." But I am bound to state that a specimen in the Levinge collection, collected by him in Sikkim in 1871, has butterfly auricles on the incomplete stipes. Another small plant got by Mr. Levinge below Dárjiling shows a section of an upright caudex.

This species grows to a very large size, as is shown even by the incomplete specimens I possess and have seen. The breadth of frond in specimens found by the Messrs. Mackinnon to the west of Mussooree is as much as  $2\frac{1}{4}$  feet ; and the stipes is more than  $2\frac{1}{2}$  feet in length. The pinnæ are sub patent, the lower few pairs becoming depressed,—the lowest pair very much so, and narrowed at the base, though the medial pinnæ have the lower segments considerably longer than those above : width of pinnæ up to  $1\frac{1}{4}$  inches. Kunze says—"Stipes, quam integrum non vidi, et rhachis basi sæpe pennam anserinum crassitie æquât." The rhachis of one specimen I have is  $\frac{1}{8}$  in. br. (where the pinnæ suddenly cease), as flattened by pressing ; and the auricled part below that point—split to facilitate drying in the press—broadens downwards until one-half is  $\frac{1}{2}$  in. and the other  $\frac{5}{8}$  in. wide, and these are not quite flat ; so that the circumference of the rhachis near its base must have been more than  $1\frac{1}{2}$  in., and the diameter about  $\frac{1}{4}$  in. The size of the stipes I cannot estimate. Mr. Trotter's specimen from the Punjab, in my possession, is very different in size, but yet is unmistakably the same plant ; it is only 2 feet 1 inch in total height, the rhachis auricled (or glanduliferous) almost to the caudex, which is erect, with stipes tufted : the frond only 6-7 in. br., and the pinnæ only about

$\frac{1}{4}$  in. Mr. Trotter said, in his "Ferns of the Punjab," (printed for private circulation), under *Lastrea ochthodes*, Kze.—"The Punjab form is mostly *var. tylodes* (Kze.) Hbk. p. 240, with the basal pinnæ suddenly (not gradually) abortive and reduced to mere auricles." His Kumaun specimen (in my possession) is a frond about 15 in. l. by 7 in. br., with pinnæ up to  $\frac{5}{8}$  in. br., and there is no apparent stipes, the glands, or representatives of pinnæ, running down close to the caudex, which is erect with tufted stipes.

It is curious that the intervals between the auricles or glands in this species decrease in length near the caudex, in my large specimens at least, instead of increasing as is the normal habit of a fern. The pinnæ are cut down five-sixths of the half width, thus leaving room for only one pair of veins to approach those of the adjoining segments below the sinus, where they merge in a thickened web which strengthens the base of the sinus. There are from 8 to 15 pairs of veins in a segment, according to the size of the frond, all simple, and very conspicuous; and all except the upper one or two pairs are soriferous for half the length of the pinna, the apices of segments and pinnæ gradually becoming bare. The sori are small, closely costal in one row on either side, the lower two or three pairs diverging: they are in large specimens didymochlænoid, or fadyenoid in shape, with the involucres persistent and longohippocrepiform like the sori. The whole frond is very stout in texture, glabrous and glossy—only the rhachises being somewhat pilose or downy. The stipes and rhachises of large specimens are sometimes pinkish in colour, which, with the deflexed lower pinnæ, gives a resemblance to *Polypodium erubescens*, Wall.

Beddome, in his Handbook, said of this fern that he believed it quite entitled to rank as a species: he had both it and *N. ochthodes* in cultivation for many years, and said that Mr. Thwaites, who cultivated them in Ceylon, considered them distinct species. But in the Supplement to his Handbook Beddome says, under *L. ochthodes*—"Omit the Ceylon locality, Thwaites' fern being *Nephrodium extensum*." As Colonel Beddome's field of cultivation was, presumably, in the Madras mountains, I consider it proved that both *ochthodes* and *tylodes* have the same habit—"caudex erect, stipes tufted," for he could not have cultivated them for many years without having observed the nature of the caudex or rhizome; and it is clear that he had not got *N. repens*. Another inference from the passage quoted above is that Beddome maintains Ceylon as a habitat for *N. tylodes*, though not for *N. ochthodes*. Mr. G. Wall seems to give only the former as a Ceylon plant, and says it is common in the higher forests of the Central Province. A specimen of *N. tylodes* collected by Levinge in the Pulney Hills, Madras Presidency, has an erect caudex, with tufted stipes, like Trotter's specimens from the Punjab and Kumaun.



9. *N. Thelypteris*, Desv.; Syn. Fil. 271; C. R. 517. *Lastrea Thelypteris*, Desv., Bedd. H. B. 241.

KASHMIR: H. & T. in Herb. Brit. Mus.; Bandipur 5500', Jacquemont, T. T.; Srinagar—City Lake 5600', Levinge 1875, Gammie 1891; Ghántamula 5000', McDonell 1891; "all through the Lolab Vy. 6000'," MacLeod 1891; Punjál, McDonell.

PUNJAB: *Chamba*—Chenab Vy.; Kajiár Lake 6000', McDonell 1885, Kajiár bog 6500', Trotter 1887; *Simla Reg.*—Kunáwar T. T.

DISTRIB.—*N. Amer.*: Canada, common; U. S.—as far south as Texas and Florida; Bermuda. *Eur.*: "throughout N. and Centr. Europe; rarer towards south: absent from Spanish Peninsula, and rare in Italy, but found in Corsica. England widely distributed, but not common: Scotland—infrequent; Ireland—rare and local, though found in many widely-separated localities" (Britten in 'European Ferns').

*Asia*: Palestine. S. India—Nilgiris, in swamp near Ootacamund 7000'. Turkestan, Amurland, and Mandschuria. Japan. Australasia—New Zealand. *Afr.*: Angola; Cape Colony. Natal. Transvaal. E. Matabeli Land. Madagascar.

The wide-creeping rhizome and roots, and young stipes and fronds before they develop are very black, as is also the lower inch or two of the stipes of fully developed fronds. This is in striking contrast with the pale yellowish green of the fronds.

10. *N. Filix-mas*, Rich.; Syn. Fil. 272; C. R. 519. *Lastrea Filix-mas*, Linn. (under *Polypodium*), Bedd. H. B. 248.

TRANS-IND. STATES: *Baraul*—Lowari Pass 9500' Dr. Harris, 1895.

KASHMIR: *Pir Panjal*—"in excelsioribus, ad torrentis, prope Hirpour," Jacquem. 38 (No. 586), small but typical; Rembiára Vy. 65-7000', Trotter No. 191, 1888; Lidderwat 9000', Trotter No. 404, 1889; Kitar Daji 6000', and Sarpat 10,000', McDonell 1891; Kachal Pass 10,000' and Dangiára 6500', McDonell 1894; Ring Nála 8000', and Kashmir (loc. ?) MacLeod 1891; Kamart Vy.—above Gumin Village 10-11,000', Duthie, No. 12524, 1892.

PUNJAB: *Chamba*—Ravi Vy., Chatri Forest 9500', McDonell 1882, Barmaur 9000', McDonell in Herb. Gamble; *Kullu*—Jalori Pass. 9000', Trotter 1887; *Simla Region*—Hatu Mt., Bliss 1891; Basahr, Brandis in Herb. Hort. Sahar.

N.-W. P.: *T. Garh.*—Dwantigadh 8000', Gamble No. 24235, 1893; (loc. ?), Herschell.

DISTRIB.—*Amer.*: from Greenland, westward and southward, along the Rocky Mts. and Andes to Peru (but this includes *N. patentissima*: see No. 10 below). *Eur.*: throughout. *Asia N.*: eastwards to China and Japan. *Afr.*: Abyssinia; Azores and Macaronesia.

Beddome in his Handbook (1883) gave as a synonym for this species *Lastrea odontoloma*, Moore (which he had figured, though but imperfectly, in his F. S. 1, t. 114), remarking that it was typical *Filix-mas*. In the Handbook the reference is to t. 14 of F. S. I., and this misprint is repeated in the Supplement of 1892, in which Moore's plant is given as *Lastrea F.-mas*, var. *odontoloma*, Moore. Elsewhere in the Supplement Beddome says the name *odontoloma* was given by Moore to Clarke's var. 2, *normalis* of *F.-mas*. Moore, being



familiar with *F.-mas* in all its forms, of course saw at once that Clarke's plant was a distinct species, and named it, as a species, accordingly. Beddome then, in his Supplement, said that the European type of *N. F.-mas* did not occur in India. And, partly misled by the heterogeneous mass of plants named *F.-mas* in herbariums, and because the Kashmir and Punjab specimens above cited had not (except Jacquemont's, which I had not then seen) then been found, I used to say the same. But there is no longer room for the slightest doubt. Trotter's plant, from the Rembiāra Vy. in Kashmir, which he noted as growing "in circular patches, like great shuttlecocks," struck me, and I then saw that his plant from Kullu, gathered previously in 1887, was the same. Shortly afterwards I found in Mr. Gamble's collection two fronds, collected by Mr. McDonell in Chamba in 1882, which Mr. Lvinge had correctly named *N. F.-mas*,—one as a variety. And Trotter's discovery in Kashmir was followed by collections made by McDonell, MacLeod, and Duthie in 1894. There is considerable difference, in this material, in the colour of the scales on stipes,—those on some specimens being very dark, and those on others very pale,—and some difference in cutting; but I think all the specimens I have noted above can be matched from among European specimens. I have separated, under the next species, *N. parallelogrammum*, Kunze (under *Aspidium*), not only *Aspidium patentissimum*, Wall., but also Clarke's varieties Nos. 3 and 5,  *khasiana* and *fibrillosa*, because I do not think they can be brought under *N. F.-mas*. Other plants, either given as synonyms or unwarrantably degraded to the rank of varieties of *N. F.-mas* in the *Synopsis*, or by Clarke and Beddome, will be found given as distinct species where I think they ought to be put.

I am aware that pteridologists are not agreed that even the European forms of *F.-mas* all belong to the same species, but I will not go into that question. I could sort the above-cited specimens into *N. F.-mas* and *N. pseudo-mas*; but as I have not seen any of these forms growing in India I think it better not to do so, especially in view of my treatment of the so-called varieties I have placed under the next species. Hooker said, in the '*Species Filicum*':—"East India, continental. The normal form is perhaps the least common, and mainly confined to N.-W. India, often at great elevations, Jacquem., Edgeworth, S. & W., Wallich (*Aspidium patentissimum*, Wall. Cat. 340), Sikkim, alt. 8-10,000', and even 15,000' (and then small) Hk. Fil. et T. Nilgiris, Wight, Bedd. Nepāl Wall., var.  $\beta$  is perhaps the next most common."

11. *N. parallelogrammum*, Kunze (under *Aspidium*), in Linnæa xiii. p. 146, *N. Filix-mas*. Rich., var.  $\beta$  *parallelogrammum*, Hook. Sp. Fil. iv. 116; "pinnate or rarely subpinnate, their segments oblong-parallelgram, very close and compact."

The following are extracts from Kunze's description :—

" 761, b — fronde lanceolata, coriacea, pinnato-profunde pinnatifida, . . . . pinnis alternis approximatis, horizontalibus, oblongis acuminatis ; acumine incisoserrato, laciniis imbricatis, oblongis, truncatis subparallelogrammis, marginatis, apice falcato irregulariter argute dentatis ; soris inter costulam et marginem mediis ; costulis costisque subtus laxe ; rhachique stipitique sulcatis utrinque dense fusco-grandi-paleaceis. "

" E regno Mexicano miserunt Hegewisch et de a Kawinski (Herb. Leucæ anum).

" Ad Preslii Lastreas § 2. Thelypteris pertinet, et A. filici-mari Sw. prope accedit. Differt vero : fronde coriacea, pinnis approximatis, laciniis imbricatis truncatis apice argute dentatis, soris costulæ minus approximatis, paleis frequentibus, elongatis, indusiisque fuscis. *Aspidium patentissimum* Wallich : fronde coriacea, pinnis approximatis, rhachique paleacea conveniens, differt laciniis majis elongatis, basi latioribus, apice distantibus. Laciniis basis abrupte majoribus, incisive, et forme laciniarum differunt. "

*a. Forma khasiana.*

*N. Filix-mas*, Rich., var. *n. khasiana*, Clarke in 'Review,' 519, t. 69, fig. 1. " Stipe and main rhachis with many linear blackish scales ; frond oblong-lanceolate, very little narrowed at base ; pinnæ approximate, patent, the lowest equal-sided, cut down to the midrib ; secondary pinnæ narrowly oblong, very close and regular, glabrous beneath, rounded, finely serrulate at the apex ; sori not large. "

PUNJAB : *Chamba*—9000', McDonell ; *Simla Region*—ridge east of Simla 8500 Blanford.

N.-W. P. : *D. D. Dist.*—Jaunsār, Mandāli 8000', Gamble 1895 ; *T. Garh.*—Nag Tiba Mt. Mackinnons 1878-79 ; *B. Garh*—Mrs. Fisher above Dhakāra, Duthie's collr 1879, Herschel 1879, and Gollan 1880.

DISTRIB.—*Asia* : N. Ind.—Assam : Khasia, alt 4-6000', common, *Clarke* ; Kohima, alt. 6,000', *Clarke*.

Clarke's type specimens of his var. *khasiana* in the Kew Herbarium seem very distinct from *N. patentissimum*, Wall. ; but in the Journ. Linn. Soc., 1889, p. 94, referring to the specimen from Kohima cited above, he says :—" This is very large, and not distinguishable from some of var. *patentissima* (sp. Wall.) from the Central Himalaya. The Khasi examples of var. *patentissima* have a soft, thick stipe with pale yellow-brown scales. " One of the Mackinnons' specimens from Tehri Garhwāl also is longer than most ; frond 25 in. l., by 9½ in. br near the base ; lowest pair of pinnæ almost 1½ in. br. ; and another is but 16 in. l., by 8¼ in. br. at base. Mr. Gamble's specimen is 19½" × 8½" ; but Mr. Blanford's is only 15 in. l., by 4½" br., and it may not be Mr. Clarke's plant.



In the "Review" Mr. Clarke remarks:—"This is the fern described by Milde, Fil. Europ. 122, lines 3—6 from the bottom of page. It is, as Milde states allied to *var. patentissima*: but, on the other hand, very near *N. elongatum*, Hk. and Gr. Ic. Fil., t. 234; *Aspidium elongatum*, Milde, Fil. Europ., 124." But  *khasiana*, and *elongatum*, Hk. and Gr., seem to me distinct enough. Though the frond of both is truncate at the base, the scales, both on stipes and frond, differ altogether." *Forma khasiana* seems to have a comparatively long (sometimes nearly as long as the frond) and slender stipes, and more numerous veins in a segment: segments finely toothed and not so squarely, ended as those of *f. patentissima*.

b. *Forma patentissima*.

*N. Filix-mas*, Rich., *var. 4 patentissima*, C. R. 520. *Aspidium patentissimum* (sp.), Wall. Cat. 340. "Stipe shaggy, with linear yellowish pales often  $\frac{1}{2}$ — $\frac{3}{4}$  in. long; frond 4—6 feet, narrowly oblong-lanceolate, widest near the middle suddenly narrowed near the base, pinnæ patent, very coriaceous, cut down nearly or quite to the midrib; segments oblong, obtuse, subentire or minutely serrulate, glabrous beneath, the margin much incurved when dry".... "*Aspidium paleaceum* Don, Prod. Fl. Nep. 4. *A. Wallichianum* and *Donianum*. Spreng. Syst. IV. 104 and Suppl. 320. Bhotán to Simla alt. 6-9000', common. Khasia, alt. 5000'.

N.-W. P.: *D. D. Dist.*—Jadusar 8-10,000', Herschel; Gamble; *T. Garh.* 8-12,000', Mackinnons; Duthie; Gamble; *B. Garh.*—Kinolia Vy. 7-8000', Duthie; Mrs. Fisher; Kumaun—Griffith; Kalimundi and near Milám 8-11,500', S. & W.; elsewhere—Davidson; Duthie, MacLeod; summit of Dhankuri Pass 10,500', Trotter. DISTRIB.—Amer.: W. Ind., Jamaica 7330', *Dr. D. Morris*; Mexico, Guatemala, Ecuador, Peru, New Grenada, and Brazil (near summit of Organ Mts.). Asia: N. Ind. (Him.), Nepál, Sikkim, and Bhotán, common; Assam—Khasia 5000', *Clarke, Mann*; S. Ind.—Nilgiris: common about Ootacamund (*Bedd.*).

This seems to be a larger form of *N. parallelogrammum*, than either *a*, above, or *c*, which follows, and 'shaggy' is not a bad epithet to apply to it. The pinnæ are very patent, becoming deflexed towards the base of the frond. The fronds are sometimes as lanceolate as a frond can be whose pinnæ do not dwindle down to auricles at the base: and I think Clarke meant "suddenly ceasing" at the base, instead of "suddenly narrowed near the base," as he puts it. Tehri Garhwál specimens have fronds up to  $3\frac{1}{4}$  feet long, by 1 foot broad, and perhaps longer, tapering gradually downwards to  $1\frac{1}{2}$  in. br., below which there are no auricles.

Milde, Fil. Europ., gives *Aspidium parallelogrammum* as a synonymi of his *var. 6* (cf *N. F. mas paleaceum*, Moore f. nat. print, and mentions a form from Khasia (*var. khasiana*, file Clarke). His varieties of *F. mas* are (1) *genuinum* Milde; (2) *crenatum* Milde; (3) *deorso-lobatum*, Moore; (4) *incisum*, Moore;

(5) *Heleopteris*, Brookhausen; (6) *paleaceum*—*patentissimum*, Wall.; (7) *Maackii*, Milde; (8) *glandulosum*, Milde; (9) *Duriei*, Milde. Hooker, in his '*Species Filicum*,' says his *var. β* (of *N. F.-mas*) *parallelogr.* is perhaps the next (sic) most common in the East Indies, and from localities too numerous to be worth recording, generally in mountain and northern districts, yet by no means confined to them." Of the American specimens he says—"All are true *var. β parallelogrammum*, Kunze, with long, crenate, paleaceous scales, and quite parallelogrammic close-placed segments and coriaceous fronds. One locality only seems to be recorded in the West Indies for *N. F.-mas*, and that is in Jamaica. Dr. Morris's ticket is: J. P. 228, from Director, Public Gardens and Plantations, Jamaica. This appears to come nearest to *Nephrodium Filix-mas*. In any case it is new to our collection, and so far as I am aware not before collected in Jamaica. Found between the Western and Middle Blue Mountain Peak, 7,330 ft., March 28, 1885, D. Morris, 4-4-85." The specimen of this in Kew is nearer *N. parallelogr.* than *N. F.-mas*, but the segments are short, rounded and toothed.

*c. Forma fibrillosa.*

*N. Filix-mas*, Rich., *var. β, fibrillosa*, Clarke in '*Review*,' p. 520, t. 70. "Stipe 1—3 in.; frond 8—30 in., very narrow, tapering at both ends, but not attenuated with articles into the stipe; stipe and main rachis densely clothed with lanceolate-linear, chestnut coloured scales; pinnæ patent, cut down to the midrib; segments oblong, obtuse, serrulate at the apex, fibrillose on the surface beneath. North-West Himalaya, alt. 9-12,000', from Kumaun to West Kashmir; very common."

KASHMIR: 5-10,000': common in many places.

PUNJAB: Chamba—Ravi Valley 9000'; Kullu 6-10,000', Lahaul 12,000', Trotter; Simla Reg.—"The Chor," Kamalhari and Hatu Mts. 95-10,000'.

N.-W. P.: D. D. Dist.—Jaunsar, Deoban 9000', Herschel; T. Garh.—Ganges Vy., Gangotri—11-12,000', Duthie; Kumaun—Davidson, Duthie.

Mr. Clarke says:—"One of the most uniform varieties of *N. F.-mas*, and the most worthy consideration for specific rank;" but I find difficulty sometimes in distinguishing it from *forma patentissima*. The smaller size and very dark-coloured scales are perhaps the best characters. The degree of fibrillosity seems to depend on age of specimen. I have seen a good deal of this growing in the Simla Region, and consider it quite distinct from *N. Filix-mas*.

12. *Nephrodium Kingii* n. sp.—Plate IX. (see Part II.; p. 621 of Vol. XII).

13. *N. serrato-dentatum* n. sp.—Plate X. (see Part II.; p. 622 of Vol. XII).

14. *N. Brunonianum*, Hook.; Syn. Fil. 84; C. R. 522, *Lastrea Brunoniana*, Wall., Bedd. H. B. 246.



KASHMIR : 95-12,000', W. S. Atkinson 1872, Levinge 1875, Trotter 1888, McDonell, MacLeod 1891, Duthie 1892-93.

PUNJAB : *Hazara Dist.*—Makra Mt. 11,000', Trotter 1889 ; Chamba—Upper Chenab and Ravi Valleys 11-12,000', Baden-Powell 1879, McDonell 1882 ; Pángi 12-15,000', Harsukh (Sahar. Herb. Collr.) 1899; Kullu, and Lahaul Trotter (in printed List) ; *Simla Reg.*—Hatu Mt., Trotter (in printed List).

N.-W. P. : *T. Garh.*—under Srikanta Mt., and Kuari Pass 12-14,000', Duthie ; Kumaun—Rálam 12,000', S. & W. 1848.

DISTRIB.—*Asia* : N. Ind. (Him.), Sikkim and Bhotan.

The cutting of this fern is certainly, as Beddome says, very like that of *N. serrato-dentatum*, but the shape of the frond is very different, and I see no difficulty in distinguishing between the two species. The fronds of *N. Brunonianum* are oblong-ovate, sometimes diminishing gradually at the base, or oblong and narrow, but always narrowing abruptly at the apex. A Kashmir specimen in my possession has a frond 12 in. l. by  $2\frac{1}{2}$  in. br. at the broadest—not four inches from the base : it remains  $2\frac{1}{4}$  in. br. up to within  $2\frac{1}{2}$  in. from the apex, being practically parallel-sided for  $7\frac{1}{2}$  of the total length. It has about 25 pairs of pinnæ 20—27 pairs of pinnæ seems to be the normal number : 12—14 pairs seems to be the normal of *N. serrato-dentatum*, besides a sharp-pointed pinnatifid apex ; and the shape of the frond of this latter mentioned species is broadly lanceolate, sometimes almost deltoid. The difference in the clothing is very that of *serrato-dentatum* being comparatively scanty. The scales of *N. Brunonianum* are often bright chestnut coloured, paler than the black stipes and rhachis. The involucre is very fugacious. Beddome in his Supplement of 1892 says Mr. Baker considers this and *N. barbigerum* as varieties of one species,—which species, however, is not said.

15. *N. barbigerum*, Hook. ; Syn. Fil. 274 ; C. R. 252. *Lastrea barbiger*, Hook., Bedd. H. B. 246.

AFGHAN. : Kurram Vy.—95-11,000', Aitch. 1879-80.

KASHMIR : 95-12,500', Levinge, Trotter, McDonell, Gammie, MacLeod—"Common, on north slopes of watershed between Jhelum and Kishenganga Valleys ; " Duthie ; below Gulmarg 6,000"—"almost in the water of a small rivulet," McDonell 1893 ; Sind Valley 10-11,000', Duthie 1892. *Muzafarabad Dist.*—Inayat (Sahar. Herb. Collr.) 1899.

PUNJAB : Chamba—Upper Chenab Valley, 10,000', Baden-Powell ; Cheni Pass ; 11-12,000', Gammie ; "Chamba," McDonell 1882-85 ; Pángi, Surál Vy., 12,500', Harsukh (Sahar. Herb. Collr. 1899) ; Head of Hudán Vy., 14,000', J. Marten 1899.

N.-W. P. : *T. Garh.*—Kidar Kanta Mt. 9000', Herschel ; Bandarpunch 13-14,000', and Bamsor Pass 11-12,000', Duthie ; *B. Garh.*—Joshi Mat 12,000', P. W. Mackinnon Kumaun—near Rálam 12,500', S. & W. ; Duthie 11-13,000', three stations ; near Pindari Glacier 10-11,000', Trotter ; Lessar Pass 16,800', MacLeod, "a solitary plant under a rock in the snows."

DISTRIB.—*Asia* : N. Ind. (Him.), Sikkim.

McDonell's gathering at about 6000', in Kashmir, which he sent to me for confirmation at the time, and MacLeod's as high as 16,800', in Kumaun, make a considerable vertical extension of distribution. Herschel's specimen from T. Garhwāl is remarkable for its comparative nakedness, and the narrowness and distance apart of its segments. Mackinnon's specimen from B. Garhwāl has dark-brown scales.

The '*Synopsis*' says this and the preceding species are closely allied to one another, but not likely to be confused with anything else. Beddome doubts their distinctness. Clarke points out that the position of the sori differs. I find the shapes of the two fronds to be constantly different: *barbigerum* is broad for its length, and ovate: *Brunonianum*—narrow, and generally oblong. The stipes and rhachis of *Brunonianum* are black—blackier than the scales: those of *barbigerum* are pale-brown—paler than the scales.

16. *N. pandum*, n. sp. (see p. 623 of Vol. XII.).

Add—PUNJAB: Chamba State—J. Marten, 1898. N.-W. P.: B. Garh.—Mrs. Fisher.

17. *N. Schimperianum*, Hochst. (under *Aspidium*). *N. Filix-mas*, Rich., Syn. Fil. 272. *N. F.-mas*, var.  $\sigma$ , *Schimperiana* (sp.), Hochst., C. R. 520. *Lastrea Filix-mas*, var.  $\nu$ , *elongata*, Hk. and Gr., Bedd. H. B. 250; *Lastrea Filix-mas*, var. *Schimperiana*, Bedd. Suppt. H. B., p. 58.

KASHMIR: Rattan Pir 8000', Trotter 1888.

PUNJAB: Kullu—Jalori Pass N. 9-10,000', Trotter 1887; Simla Reg. 55-8000', and perhaps higher: very common in Simla.

N.-W. P.: D. D. Dist.—Mussoree 6500', Hope 1890 (1 plant); Landour and to the eastward, above 7,000', abundant; T. Garh.—Kidar Kanta Mt. 6000' Herschel; Jumna Vy., near Kharoli 9-10,000', Duthie; B. Garh., Duthie, Mrs. Fisher; Kumaun 5-9000', several collectors; Gori Ganga Vy. near Buin 3400', and above Bilkot 10,000', MacLeod 1893.

DISTRIB.—Asia: N. Ind. (Him.), Sikkim and Bhotan. Assam—Khasia 5-6500' "very common," Clarke, Mann; Naga Hills—Kegwima Edge 7000', Clarke 1885.

Beddome says, in his Supplement of 1892, "The typical form of this is well marked, . . . . it is intermediate between *cochleata* and *odontoloma*, Moore. There are two forms in N. India, a large and a small variety, I have only seen the latter (*L. intermedia*, Bedd. F. S. 1, t. 311) in Southern India." The figure here referred to does not suggest *N. Schimperianum* to me. I think this well-marked fern can afford to stand alone without the support of *N. cochleatum* and *N. odontoloma*, to which latter species at least it has no sort of resemblance or affinity.

N.-W. Indian specimens seem to run much larger than those from Sikkim, Assam and Madras, but some of them are as small as any from elsewhere. One of Trotter's plants from Rattan Pir in Kashmir has five fronds, none of which are over 7 in. l., including stipes: three of them are fertile. The cutting of this



species varies a good deal, but not with the size of the frond. One frond I collected in Simla in 1871, about 25 in. l. by  $8\frac{1}{2}$  in. br. is only bipinnatifid, and the segments are not lobed—only slightly toothed. Another I got at Mashobra (Simla Region) in 1886—matched by a frond of Strachey and Winterbottom's from Kumaun—may be said to be bipinnate, *i.e.*, there is hardly any wing to the secondary rhachis in the greater part of the frond, though the pinnules are sessile with a decurrent base. The bipinnateness decreases in the lower part of this frond, and is quite lost in the lower two or three pairs of pinnae, as it is towards the tips of all. This frond is 28 in. l. by 10 in. br. and has a stipe 13 in. l. The segments are distinctly lobed, and the 8—10 lobes are toothed. The veins are distant, one to each lobe, and pinnate in the lobes. The sori of this specimen are uncharacteristically small,—one at the base of each vein close to the midrib, except in the tips of the pinnules.

The scales of *N. Schimperianum* (the Indian plant) at base of stipes are long, linear, in a dense mass; higher up there are both large, broad, scales, with fibrillose twisted tips, and very narrow ones. All are always pale-brown, transparent. The caudex is decumbent, and stipes tufted, but not densely so, and spreading. The fern generally grows on steep ground, and is often rooted in the clefts of rocks; and the fronds droop more or less.

I have seen quantities of *N. Schimperianum*, *N. marginatum*, Wall. and *N. odontoloma*, Moore, growing together, near Landour, but never the slightest passage from one to the other.

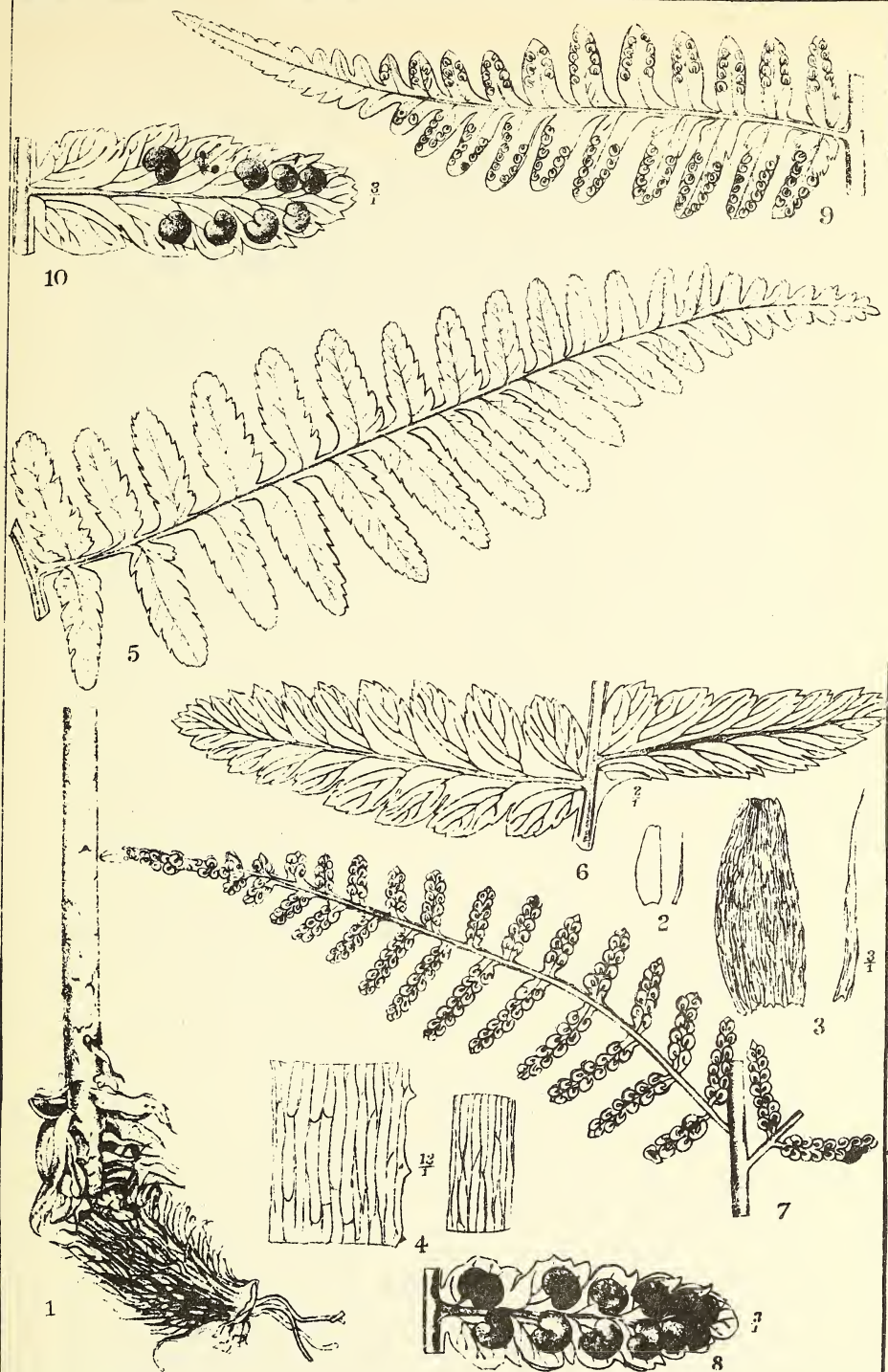
Dr. Christ, who has compared Indian specimens of this fern with specimens of *Aspidium Schimperianum* in his own herbarium, collected by Schimper in Abyssinia, considers it imprudent to identify them, seeing that the type plant is markedly bipinnate, and has a large deltoid frond. The type specimens in Kew, from Abyssinia, are wider below, and more compound, than any Indian ones.

18. *N. cochleatum*, Don (under *Aspidium*). *N. (Lastrea) Filix-mas*, Rich., *N. cochleatum*, Don, Syn. Fil. 272. *N. cochleatum*, Don (under *Aspidium*), C. R. 521. *Lastrea Filix-mas*, L., var. *cochleatum*, Don, Bedd. H. B. 250. Plate XXX.

PUNJAB: *Chamba*—McDonell; *Kangra Valley* Dist. E 4000', Trotter; *Simla*, Reg.—*Simla*. It does in ascertained height as mentioned.

N.-W. P.: *D. D. Dist.*—in the Dún (Valley) 1,550' to 3,150', very common, and (abundant in places); *T. Garh*, 4-5000', Duthie, Hope; *Sahranpur Dist.*—Siwalik Range, on south side, MacLeod; *B. Garh*. Mrs. Fisher; *Kumaun*, S. & W., Hope Davidson, Duthie, 25-6000'.

DISTRIB. Asia: N. Ind. from Oudh to Bhotan; Assam—Khasia; Bengal—Chittagong, and Parasnath Mt. up to 4000', very common; Burma—Ava, Malay Penins. *Clarke in Rev.*, S. Ind.—Western Mts., 2-4000' (*Bedd. in H. B.*).



J N Fitch del.

Chitra Silpi C<sup>o</sup> Lith

## NEPHRODIUM COCHLEATUM Don.

- |                                      |   |
|--------------------------------------|---|
| 1. Base of stipes, nat. size         | 6. Pinnules from sterile frond $\times 2$ diam. |
| 2. Scales from " " "                 | 7. Pinna of fertile frond, nat. size.           |
| 3. " " " $\times 3$ diam.            | 8. Pinnules of " , enlarged 3 diam.             |
| 4. Portion of do. $\times 12$ diam.  | 9. Pinna of semi-contracted frond nat. size     |
| 5. Pinna of sterile frond, nat. size | 10. Pinnules of " , enlarged 3 diam             |





Wallich thought this fern so distinct from any other that he made a new genus for it—*Arthrobotrys*, meaning, I presume, that the sorus or bunch of sporangia was attached to the frond by a joint,—and he gave it the specific name *macrocarpa*. The involucre completely envelopes the sorus, and the whole bunch on a stalk can be detached, even in old dried specimens, from the segment, the involucre being like a thin shell. Sometimes it separates from the frond and turns upwards, but it is always persistent. The “*Synopsis*” gives the generic synonym, and, also, *Dryopteris*, Schott. And Clarke gives *Arthrobotrys macrocarpa*, Wall., Cat. 395, and *A. avana*, Wall., Cat. 1034, as synonyms. Beddome also mentions those, and says that *A. avana* is from Ava, with the fertile segments so contracted as to be quite beadlike. All the descriptions state that the sterile and fertile fronds are different, though Mr. Clarke says that barren fronds partially fruit-bearing are not rare, and Colonel Beddome that the fronds are generally dimorphic. This is a very common fern in the Dehra Dun, and I should say that a partially-contracted frond is a very rare occurrence. I can see in this fern no resemblance to *N. F.-mas*, or connection with that or any other *Lastrea*. The general aspect of the plant, which sometimes grows in a thick bed or large patch, is—a number of broad leafy sterile fronds bending backwards, and one or more fertile fronds standing stiff and erect in the middle, and much higher than the rest, the stipes being very long, round, and stout. The fertile fronds are often found to have been eaten off by cattle or deer, I presume. The plant loves a clay or rich loamy soil, moisture and shade, or rainy or hilly ground, under trees or among bushes.

*N. cochleatum* is never truly bipinnate, even in the fertile fronds, the segments being cordate on the superior side and decurrent to a winged rhachis on the inferior,—the wing being traceable throughout. The veins, sometimes very obscure, are pinnate in the lobes; veinlets few and long. The caudex is decumbent like that of *N. marginatum*, Wall.: stipes tufted. A section of the caudex shows black striæ in the woody structure, which are wanting in *N. marginatum*. Beddome says of *Lastrea cochleata*—“A very distinct-looking plant at low elevations, but running into *elongata*” (i.e., *N. marginatum*) “at higher elevations (*vile* forms of my collecting on the Nilgiris and Brumagherries in the British Museum).” He also, in a letter, referred me to that suite; but I found only about two specimens in it which I could not at once sort according to my lights. Mr. Clarke says *N. cochleatum* has been confused with *vars. intermedia*, Bedd., and *Schimperiana*, Hochst., of *F.-mas*, and that it resembles them in having large involucres. “Its especial character is its strong dimorphism; it is worthy, perhaps, of generic rank.” He further says there are no forms intermediate between *N. cochleatum* and *N. elongatum* at Kew, nor has he ever met with such in India. “There are examples of *N. cochleatum*

marked as collected at 7000' alt., even in Kumaun; but the fern is confused with *N. Filix-mas*, var. *Schimperiana*, and I very strongly expect that collectors have mixed the two before distribution: I altogether doubt high-level localities assigned to *N. cochleatum*." I quite concur.

[*N. rigidum*, Desv., was given by Mr. Clarke at p. 523 of his 'Review' as an Indian fern, and I do not think he gave it up in his later papers. I know the European fern, and I can say that I have seen nothing very like it from the Himalaya. I do not think *N. pallidum*, Bory, is very near *N. rigidum*, though I think it is probably identifiable with the Himalayan *N. odontoloma* (Moore), Bedd. Beddome also had *Lastrea rigida* as an Indian species in his Handbook. He said it was very near *L. Filix-mas elongata*, and he did not know any distinguishing character. Since then he must have seen the European *N. rigidum*, for in his Supplement of 1892 he says, under *Lastrea rigida*,—"All the specimens I formerly referred here I now refer to *Filix-mas elongata*. I much doubt if this species is represented in Northern India, at least as distinct from *remota*." He then proceeds to treat of *Lastrea spinulosa*, var. *remota*, as an Indian fern.]

[*N. remotum*, Hook., Brit. Ferns t. 22; *N. spinulosum* Desv., *remotum* (A. Br. sub *aspidium*), Bedd. H. B., p. 252; *A. remotum*, A. Br. This plant is included by Clarke in his 'Review' as an Indian fern, and by Beddome as mentioned above. As I have never seen Indian specimens which agree with European specimens, and have, moreover, reasons for agreeing with Milde that *N. remotum* is a hybrid between *N. Filix-mas* and *N. spinulosum*, I do not admit this as an Indian species, and have instead given *N. Blanfordii* n. sp. No. 18, below.]

[*N. (Lastrea) spinulosum*, Desv. is stated in the 'Synopsis' to be found in the Western Himalaya; but neither Clarke nor Beddome corroborates the statement, and I have never seen Indian specimens. It is said to have been collected in the Gilgit District of (Trans-Indus) Kashmir by Colonel Tanner in 1880, at an elevation of 8600'; but the specimens are only two barren fronds without rhizome. I have my doubts.]

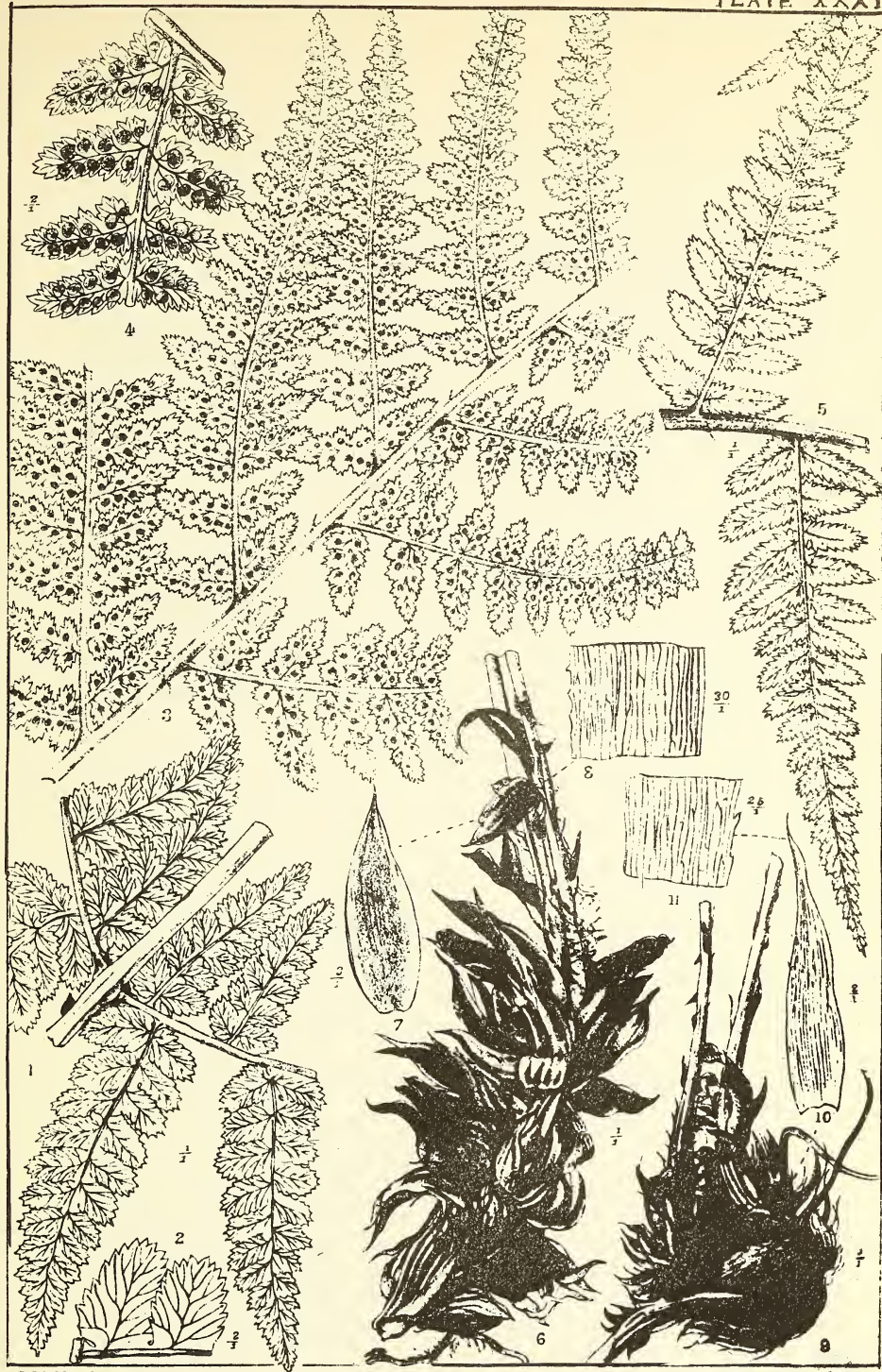
19. *N. Blanfordii* n. sp.—Plate XI. (see p. 624 of Vol. XII.)

Add:—KASHMIR: Kishenganga Valley, 7-8000', Duthie 1892; Baltistan, 12-13,000', Duthie 1892; "Kashmir," McDonell 1894.

PUNJAB:—Hazara Dist.—Kagan Valley, Duthie's Collr. 1899; Chamba—J. Marten 1897-98; Pangt 8500', Harsukh 1899.

20. *N. odontoloma*, Moore (under *Lastrea*), Index-Filicum, MS.; Bedd. F.S.I., 39, t. 114; *Lastrea Filix-mas*, var. *odontoloma*, Moore, Bedd. Suppl. H. B. 55. *N. Filix-mas*, Rich., var. 2, *normalis*, C. R. 519, t. 68, fig. 2.—





J. N. Fitch del

Chitra Silpa C<sup>y</sup> Lith

NEPHRODIUM ODONTOLOMA Moor.

1. Basal pinnae of a large frond.
2. Segments of a pinnule  $\times 2$  diam.
3. Portion of upper part of same frond.
4. Portion of a pinna from do.  $\times 2$ .
5. Pinnules from a small specimen, nat. size.
6. Base of stipes of frond N°1.
7. Scale from do  $\times 3$  diam.
8. Portion of do enlarged 30 diam.
9. Rhizome and stipes of a small frond.
10. Scale from N°9, enlarged 2 diam.
11. Portion of N°10, enlarged 25 diam.





Plate XXXI. *Plants* isolated. *Caud.* decumbent, slow-growing, throwing up a few fronds from the apex annually, and perishing behind, densely clothed with large, broad, acuminate scales. *Stipes* curving upwards to the vertical, densely clothed at base with linear, subulate, concolor, light-chestnut-coloured scales,  $\frac{3}{4}$  in. l., higher up with larger and broader scales up to 1 in. l., very acuminate, dark-chestnut-coloured, still higher up shortening to  $\frac{1}{2}$  in., with pale edges, and becoming scattered and deciduous; stiff but not thick; from 6 in. in small to 23 in. l. in large plants,—average of 25 large fronds 14 in. *Fronds* from 8 to 23 in. l., by 4 to 13 in. br., ovate-acuminate: sometimes the lowest pair, or the two lowest, sometimes the third and fourth pairs from base, sometimes the middle pairs, the longest: bipinnate. *Pinnæ* oblong-acuminate, generally broadest at base, occasionally at middle, pinnate to a slightly winged rhachis, distant, pinnules generally set well apart. *Pinnules* generally sessile, but lowest often petiolate, broadest at base, slightly falcate and tapering to a rounded apex, cut down more or less into distinct, blunt or truncate, sharply-toothed lobes, 4-6 in number according to length of pinnule, the toothed margin thin in texture, almost hyaline, with a tooth to each veinlet. *Veins* distinctly visible, pinnate in the lobes: veinlets curved, in lower lobes often forked in the inferior half, running into the teeth but stopping short of the margin, clubbed at the ends. *Sori* in a single row on either side of costa of pinnule, one in each lobe, but often two in each of the lowest pair; lowest 3-5 pairs of pinnæ sterile. *Texture* herbaceous; colour of stipes and rhachises pale-straw-coloured, or light brown: of lamina pale, dull, green.

AFGHAN.—Griffith; Kurram Valley—Aitch. Nos. 384 and 455, 1879.

TRANS-IND. STATES: Chakdara, Duthie's Collr. 1895; Baraul and Swât—with the Chitral Relief Expedition, 6 stations, 63-10,000', Harris 1895; Mirga 8000', Sir W. Gatacre 1895.

KASHMIR?—"Kashmir and W. Thibet, J. E. Winterbottom 1847, No.—, Habitat Birik in Gilgit (Balti or Lower Thibet), elevn. 10,000 ft.;" Rutton Pir 8000', C. B. Clarke, No. 28310, 1876; Srinagar, Bamahama, and And'rubug 5-7000', "common" MacLeod 1891; Jbelam Valley, 3000', Gammie 1891.

PUNJAB: *Dehra Ismail Khan*—Pingul, Rev. J. Williams 1888; *Hazara Dist.*—Black Mt., Akhand Baba Peak, and Kahim Gali 8-9000', Panj-Gali 6-7000', Duthie Nos. 7622-23, 1883; Kagan Valley. 5-8500', Inayat (Sahar. Herb. Collr.) 1896-97-99. Abbotabad to Murree 7-9000', Trotter 1889; Murree 5-7000', Hope 1882; *Chamba State* McDonell, Trotter, J. Marten 1898-99, Harsukh (Sahar. Herb. Collr.) 1899; *Kangra Vy. Dist.*—Dharmasala 8000', Trotter 1887; Simla Reg. 5-10,000', Hope, Gamble, Blanford, Duthie, Bliss.

N.-W. P.: *D. D. Dist.*—Jaunsar 45-8000', C. G. Rogers, Gamble; Mussooree 6-7000': the common *Lastrea* of Mussooree; *T. Garh.*—King, Duthie, Gamble; *B. Garh.*—Mrs. Fisher; *Kumaun*—Hope, Davidson, Trotter, Duthie.

DISTRIB.—*Asia*—*Centr.*: N. Ind. (Him.) Sikkim, Bhotan; Assam—Khasia Hills, Clarke, Mann; "not very common" (Clarke in 'Rev. '); Kohima 4500', Clarke S. Ind.—Nilgiri and Annamalai Mts., above 5000', *Beddome*, *Levinge*, *Gamble*.

The above description has been written by me from a large series of specimens. I first gathered this fern at Naini Tal in 1861, and again at Simla in 1871. I was very familiar with it at Mussooree from 1880 to 1896, where it is one of the commonest ferns in and near forest, on the north side of the ridge. On dry ground it is small and poor, and like Clarke's type of *N. F.-mas*, var. 2, *normalis*; but in rich moist soil, in open shade, it develops into a large handsome plant, with a number of fronds growing up simultaneously from the apex of a suberect or decumbent stout caudex, but not shuttlecock-wise from an erect caudex, like the fronds of *N. F.-mas*. Generally the four, always three, lowest pairs of pinnae are barren, and not uncommonly five pairs. This may be taken as a character of the species. The sori are small, but the involucres when young are twice as large as the sori, shrivelling up when they ripen. The pinnae are all distant, increasingly so downwards to 3—3½ in. apart in large fronds. The stipes is generally long. Before I saw this fully-developed state of the plant I thought the Mussooree fern must be Clarke's *normalis*. I objected to the species being put under *F.-mas*, and when, later, I received Assam specimens from Mr. Clarke, I identified them with the small form of the Mussooree fern. When I went to England in 1888, and studied at Kew, I noted—"No specimen that I have, or have seen, marked var. *normalis* by Mr. Clarke is at all like *N. Filix-mas*, either in stipe, shape of frond, cutting, or sori." I classified on paper all the specimens like *normalis*, or like the Mussooree larger fern, into groups:—I. Old specimens, identical with Clarke's own, found freely scattered through bundles marked as containing not only *N. F.-mas*, and varieties of it, but *N. rigidum*, Desv., and these Mr. Clarke had apparently not identified as his *normalis*. The earliest collected of these is, I think, a frond collected by Jacquemont at Mussooree, No. 592, and it had been marked *N. remotum* by Mr. Clarke. Another, from Afghanistan, Griffith, Mr. Clarke had marked *N. rigidum*, Desv. Two or three sheets, of Dr. Bacon's collecting, have tickets—"Mussooree, abundant," and—"N. West India, Mr. Edgeworth." There are about a dozen sheets of these old specimens, collected from Kashmir to Kumaun, but all unmistakably *N. odontoloma*, Moore.

Group II. comprises seven sheets of Mr. Clarke's own collecting in Kashmir and at Dalhousie in the Chamba State, marked *rigidum* or *remotum*. A wrapper marked by him "*Ind. Or. rigidum*," contained either *N. marginatum*, Wall., or very large and compound specimens of the Mussooree *normalis*, collected by Jacquemont, Strachey and Winterbottom, Hook. fil. et Thoms., and Edgeworth. None of these seemed to me in the least like the European *rigidum* or *remotum*. Some loose sheets had mostly been referred to *rigidum*, though they were not in a *rigidum*-wrapper. I thought them not even like that species. Many were named *pallidum* by the collectors, which name well indicates their



tint of green. There is a great resemblance between *N. odontoloma*, Moore, and *N. pallidum*, Bory; and some specimens of Dr. Aitchison's from Afghanistan, which I at first referred to *odontoloma*, may be *pallidum*, if these are distinct species. There is a whole plant of his, No. 455, "Shand Toi ravine, Aspidium Filix-mas, 31-5-79," which is exactly Clarke's Assam *normalis*, small and simple in cutting, but very pallid. Mr. Baker has marked this—"doubtful—between *rigidum* and *Felix-mas*." Under *rigidum*, which he seems to have erroneously introduced into the Flora of India, Mr. Clarke says—"Some of the Indian examples exhibit the whitened appearance of *N. pallidum*, Bory; and Sir W. J. Hooker has written that name on one of them. Some forms included by me under *N. Filix-mas*, var. 2, *normalis* above, become 2-pinnate, and I can draw no line between them (Khasi examples) and *N. rigidum*." From this it would appear that the large N.-West Himalayan form of *N. odontoloma* grows also in Assam; but Mr. Clarke gives no dimensions, and his figure is of the small form.

Later on, after a discussion, Mr. Baker allowed me to pick out of all these wrappers the specimens I reduced to *normalis*, alias *N. odontoloma*, Moore, and Mr. Clarke pinned additional tickets on them, bearing that name, on my responsibility. Colonel Beddome, in his Supplement, under *Lastrea F.-mas*, var. *odontoloma*, Moore, makes no mention of this re-sorting done at Kew; but under *Lastrea spinulosa* var. *remota*, he seems to refer to specimens of *N. odontoloma* I contributed to Kew when he says—"Mr. Hope has also sent specimens to Kew, gathered at the base of the Himalayas, in which the pinnules are much less cut than in the type, which have been referred to *rigida*, var. *pallida*." The specimens I sent, which are admitted by Clarke to be his var. *normalis*, well developed, were not gathered at the base of the Himalaya, but over the outer ridge of the range at an elevation of about 6,300 feet, and no specimen of this plant has ever been got at the base of the Himalayas.

Large specimens of *N. odontoloma*, Moore, and also of *Aspidium marginatum*, Wall., are quite bipinnate in the lower half: *N. F.-mas* is never bipinnate. *Nephrodium elongatum* (Sw.), Hook. & Grev., is somewhat like *N. odontoloma*, and very unlike *F.-mas*. It is not bipinnate, and the lowest two pairs of pinnae, which are not much shorter than those above them, are less bipinnate than the third and fourth pairs are.

21. *N. ramosum*, Hope, in Journ. Bot., March 1896, p. 126.—"Rhizome procumbent" (plants isolated), "ligneous, densely clothed, as are the bases of the stipes, with large, broad, suddenly-acuminate hair-pointed pale-brown self-coloured scales. Stipes 6-17 in. l., stout, pale-brown or straw-coloured, sometimes mottled. Frond 10-24 in. long by 8-18 in. br., bipinnate in lower part; rachises slightly winged in upper pinnae; lowest pinnae as long, as or longer than the next above, and the lowest four or five pairs but



little diminished in length, diminution thence gradual to apex; *rhachises* straw-coloured, or pale-brown, or pale-green, more or less clothed with pale-coloured linear scales and fibrils, but sometimes glabrous; frond plumose in appearance. *Pinnæ* ascendant, 16-30 pairs beside the deeply-pinnatifid apex, distant near base of frond, lowest 5-9½ in. l. by 2-4¼ in. br. *Pinnules* 12-20 pairs, on the lower *pinnæ* much longest on the lower side, longest towards the middle and then up to 2½ in. l., none ½ in. br., and all distant, falcate; oblong for two-thirds of their length, and then acuminate, cut down to a winged rhachis into 10-15 segments; segments in large fronds lobed on both sides, and lobes toothed. *Texture* herbaceous. *Colour* pale-green, but drying sometimes pale-brown. *Veins* pinnate in segments, and forked in larger lobes. Sori generally absent in lowest two or three pairs of *pinnæ*, but extending sometimes almost to the apices of fronds and *pinnæ*, up to six in lowest lobes, medial. *Involucres* thick moderate-sized, persistent, brown; sporangia pale-green when young."—Plate XXXII.

*Afghan.*: *Peiwar Kotal* 8000', the late Sir Henry Collett 1879; *Aitch.* 9000, No. 266, 1880 (named *N. rigidum*, var. *pallida*).

TRANS-IND. STATES: with the Chitral Relief Expedition—72-10,000', Dr. Harris, Sir Wm. Gatacre.

KASHMIR, W.—4-10,000', Trotter 1888, MacLeod 1891, McDonell 1891 and 1894, Duthie 1892-93.

PUNJAB: *Hazara Dist.*—"The Gallies," Mrs. Queripel 1882; Kagán Valley Inayat (Sahar. Herb. Collr.) 1896-7-9; between Abbotabad and Murree 7-8500', frequent, Trotter 1888-89 and 1892; *Simla Reg.*—8-9000', Blanford 1882-84, Hope 1886, Bliss 1891.

N.-W. P.: *D. D. Dist.*—Jaunsar 8000', Gamble 1892-95-98; *T. Garh.* 8-9000', Duthie 1883.

The characteristic features of this fern are—the broad frond, hardly ever reduced at the base: the very long, broad and distant *pinnæ*: the very long and narrow *pinnules*: the pale-green colour of the frond, and the almost invariably pale colour of the scales. The distribution seems to be confined to the Western Himalaya and the mountains immediately to the westward of British India. In colour it is similar to the much less compound *N. pallidum* of Bory, a native of South-Eastern Europe and Western Asia. Some specimens of *N. ramosum* approach *N. odontoloma*, and others *N. marginatum*, Wall., which varies a good deal. But *N. odontoloma* never is broadest at base as *N. ramosum* is almost invariably. Perhaps the nearest congener of this species is *N. Blanfordii*, Hope, No. 18 above described, a fern with a more limited range; but that species is never so compound in cutting, and it always has a short stipes, and dark-coloured scales.

22. *N. marginatum*, Wall. (under *Aspidium*), Cat. 391, mainly, but not the type sheet; C. R. 521, t. 71; *Aspidium marginatum* (not clearly separable from), *N. elongatum*, Hk. & Grev., Syn. Fil. 272. *Lastrea Filix-*



J. N. Fitch del.

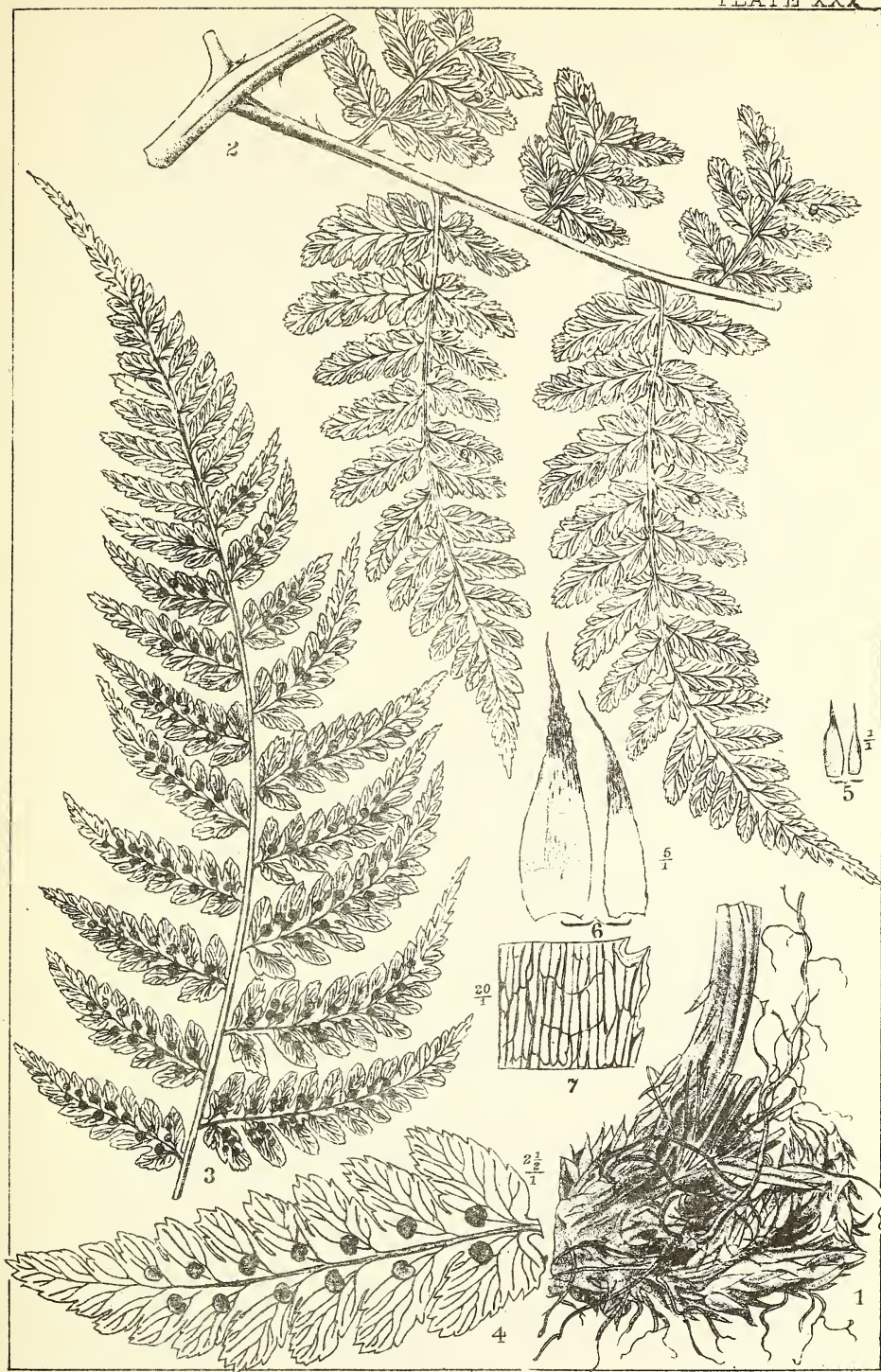
Chitra Silpi Co. Lith.

## NEPHRODIUM RAMOSUM Hope.

1. Section of rhizome, nat. size.
2. Portion of frond, nat. size.
3. Pair of pinnules, enlarged 3 diam.
4. Sorus, enlarged 20 diams.
5. Scale from base of stipes,  $\times 7$  diam.
6. Portion of same scale,  $\times 80$  diams.







J.N. Fitch del.

Chitra Silpi C. Lith

## NEPHRODIUM MARGINATUM Wall., (Sub Aspidium)

1. Rhizome natural size.
2. Stipes from a basal pinna: nat size.
3. Upper fronds of a pinna: nat size from same frond.
4. Pinnae of No 3. enlarged  $2\frac{1}{2}$  diam.
5. Scales from base of stipes nat size.
6. Upper fronds of a pinna: nat size from same frond.
7. Portion of scale enlarged 20 diam.





*mas*, var.  $\gamma$ , *elongata*, Hk. & Grev., Bedd. H. B. 250, and Suppt. 56. Plate XXXIII.

Mr. Clarke's description is :—"Frond large, oblong or ovate-lanceolate, not narrowed at the base, 2-3 pinnate; lowest pinnae often 12 in. l., falcate; main and partial rachises nearly free from scales; tertiary pinnae oblong, obtuse, serrate or pinnatifid sometimes nearly to the midrib; texture, venation, and sori nearly as *Filix-mas*.—Himalaya, alt. 6-9000', from Bhotan to Kumaun, common in Sikkim; Khasia, alt. 5000'; Kohima 6000'."

Mr. Clarke observes :—"This form is called var. *elongatum* (of *N. F.-mas*) in the Kew bundles, and also by Indian collectors; but I do not see that it is much like *N. elongatum*, Hk. & Gr., Ic. Fil. t. 234 (*Aspidium*, Milde, Fil. Eur. 124), which is founded on a Macaronesian fern that seems to me much more like var. *Khasiana*." In this I quite concur, but I cannot do so in what follows the above. *N. marginatum*, Wall., is quite common as far westward as Simla, and even in Western Kashmir, according to Col. MacLeod; and I have a specimen from the Hazara District collected by Mr. Trotter. I give the habitats I have notes of—as follow:—

KASHMIR: On the range between Jhelam and Kishenganga Valleys—"common from 6 to 11,000'," MacLeod in MS., 1893.

PUNJAB: *Hazara Dist.*—near Dungagali 7000', Trotter No. 546, 1890; *Chamba*—below Dalhousie 5000', Blanford 1886; McDonell; *Kangra Vy. Dist.*—Dharmasála 6500', Trotter; *Simla Region*—Simla 5500'-6000', Hope, Blanford, Bliss.

*N.-W. P.*: *D. D. Dist.*—Mussooree and neighbourhood, from 5000 to 6950', common in forest. *T. Garh.*—Aglár Valley, Duthie; *Kumaun* 47-6000.

DISTRIB.—*Asia*: N. Ind. (Him.), Sikkim (common), Bhotan; Assam—Khasia 5000', Kohima 6000' *Clerke*. S. Ind., on the Western Mts., 4-6000', *Beddome*. Ceylon (*Beddome* H. B.). Malay Peninsula—Perak (*Beddome* Suppt. H. B.).

The description of *N. elongatum*, Hk. & Gr., given in the '*Synopsis*' under *N. Filix-mas* Rich., is:—"fr. sometimes 3-4 ft. l., 2 ft. br., subdeltoid, quadripinnatifid; lower pinnae 1 ft. or more l., 4-6 in. br., pinn. close, lanceolate, cut down nearly to the rachis into oblong crenated lobes; invol.  $\frac{1}{3}$ — $\frac{1}{2}$  lin. br.;" and the concluding remark, under *N. F.-mas*, in which is included *N. elongatum*, as var.  $\gamma$  is—"The extremes as described differ widely, but we cannot draw any clear line between them. *A. Schimperianum*, *canariense*, *Ludovicianum*, and *marginatum*, none of them seem clearly separable from  $\gamma$  which might be looked for in group 7," Group 7, when we come to it ten pages further on in the '*Synopsis*,' contains 28 species with fronds ample, more than  $1\frac{1}{2}$ —2 ft. l., 1 ft. br., decom-pound.

Had the description of *N. elongatum* given in the '*Synopsis*' been simply of the Macaronesian plant, as figured in Hooker and Greville's *Icones Filicum*, the suggestion that the fern might be looked for in group 7 of *nephrodium* could hardly have been made. The figure is of the Madeira fern, as gathered

there, at Ribeiro d'Amestade, and the description in the *Icones* is said to have been made from the frond figured; but it goes beyond that, and seems to have been intended to cover also *N. canariense*, A. Br., which Milde considered to be a distinct species. So also does the description in the '*Synopsis*' seem to have been designedly made comprehensive; and afterwards it was thought sufficiently so to cover also *N. Schimperianum*, Hochst., and *N. marginatum*, Wall. And, next, the habitats were extended eastwards from the Macaronesian Islands, over nearly all Africa, and the East Indies, and westwards to the South United States. I cannot find any specimen of *N. elongatum*, as figured by Hooker and Greville, marked as having been collected in the Canary Islands; nor does it seem to have been got on the Continent of Africa. Nor can I find any specimen of the more compound (or decompound?) plant, *N. canariense*, marked as having been got either on Madeira or on the African Continent. But I must point out, in spite of Milde's opinion that it is a distinct species, that *N. canariense* appears to be closely connected with *N. elongatum*, for it shares with it two characters which I cannot find in *N. Filix-mas*, or in any African or Indian plant named *N. elongatum*. These are (1), as stated in Hooker and Greville's description,—“the underside (of the frond) is minutely dotted with crystalline glands, and the involucre, which is very convex, is also studded with glands, some crystalline, some opaque (sic)”; and (2)—which I cannot see anywhere noted—the secondary rhachises, and in a less degree the costæ of the pinnules, or the tertiary rhachises, bear peculiar small, rounded, pointed scales. These scales I cannot find on any form of *N. Filix-mas*, or on any other so-called variety of it, or on *N. marginatum*, Wall., or on any continental African species or form.

The difference in cutting between even the largest specimens of *N. canariense* and the smallest and least compound (or decompound) specimens of *N. marginatum*, Wall., is very marked; and the very patent and closely-set pinnæ and pinnules of *N. elongatum*, Hk. & Gr., and *N. canariense*, A. Br., are in marked contrast with the ascendant and widely separated corresponding parts of *N. marginatum*, Wall. The texture and colour of the two species are very different; and the scales at base of stipes are utterly dissimilar from each other as well as from those of *N. Filix-mas*.

*Nephrodium elongatum*, Hk. & Gr., is, as these authors say, *Aspidium elongatum*, of Swartz, Syn. Fil. p. 55, Willd. Sp. Pl. v. 5, 269, 1779, which again is the *Polypodium elongatum*, of Aiton, in Hort. Kew. Ed. 1, v. 3, p. 465, and Ed. 2nd, Vol. V., 1813. The type of *Polypodium elongatum* is in Herb. Hort. Kew.—ticket—“*Polypodium elongatum*, Solander, n. sp. 1781,” Herb. late Bishop Goodenough, presented by the Corporation of Carlisle, June 1880. This has the characteristic scales, described above, on the secondary rhachises and

costæ : the stipes are incomplete, and there is no rhizome. *Tectaria elongata*, Cav., is quoted in the *Icones* as a synonym. The following remarks are made, after the technical description :—

“This fern appears to be very little known to botanists, and we are much indebted to the Rev. R. T. Lowe for sending us five specimens gathered in Madeira, at Ribeiro d’Amestade, at an elevation of 3,000 feet above the level of the sea, and from which our figure and description have been made. These, too, we have had an opportunity of comparing with an authentic specimen of Mr. Masson’s, and thus determining it to be the *Polypodium* of the *Hortus Kewensis*.” None of the authors, Aiton, Swartz, and Hooker and Greville, give any habitat for the plant, except the islands of the Macaronesian group ; and as there is plenty of specimens in the Kew Herbarium, from Lowe and other collectors, named *N. elongatum*, there can be no dispute as to what the type plant is. As the plant was in cultivation in the Royal Gardens, Kew, in Aiton’s time, and as it has a place in the *Hand-List of Ferns and Fern Allies* cultivated in the Royal Gardens, and it would be interesting to compare the fronds now growing with the old Herbarium specimens, and others more recently collected in Madeira, I have tried to find the plant referred to in the List, but without success. No one in the Gardens seems to know of the existence of the plant, or to be able to find it. The Growing ferns are not arranged according to any system of classification, and they are therefore not so available for study as they might be. But I am safe in challenging any one to show any connection between *N. elongatum* and *N. marginatum*, Wall.

23. *N. sparsum*, Don (under *Aspidium*); Syn. Fil. 276 ; C. R. 523. *Lastrea sparsa*, Don, Bedd. H. B. 252.

PUNJAB : *Chamba State*—Ravi Valley-Langera 6500', McDonell 1882.

N.-W. P. : *T. Garh.*—Duthie 1877, Herschel 1878-79; Phaidi, E. of Landour 5-6000', Duthie 1881; *Kumaun*—near Askot 4-5000', Duthie 1884.

DISTRIB.—*Asia* : N. Ind. (Him.), Sikkim and Bhotan ; Assam—“very common eastward.” C. Prov.—Pachmarhi, *Duthie*. S. Ind.—Mahableswhar ; “abundant on all the western Mts., and on the hills on eastern side” (*Beddome*). Ceylon. Thibet *H. E. Hobson*, Burma, Malay Isles. N. China Yunnan—*Henry*. Formosa. Java—*Raciborski*, Borneo.

Mr. McDonell’s fern from Chamba seems very different from the Garhwāl plant. It is very elegant in cutting, and, though small, is all but tripinnate ; stipes and rhachis reddish in colour ; it is perhaps a distinct species. The Garhwāl plant is hardly bipinnate.

24. *N. crenatum*, Baker, Fl. Mauritius 497. *Polypodium crenatum*, Forsk. *N. odoratum*, Baker, Syn. Fil. 280. *N. crenatum*, C. B. Clarke, C. R. 524. *Lastrea crenata*, Forsk. (under *Polypodium*), Bedd. H. B. 258.

PUNJAB : *Hazára Dist.*—near Kalapani 6000', Trotter 1890 ;—*Chamba State*, McDonell ; 6-7000' Trotter ; Mandi State 5-6000', Trotter ; *Simla Reg.*—Simla to Kamalhari Mt., and Sutlaj Valley, 3-8500' or higher, Gamble, Hope, Bliss,



N.-W. P. : *D. D. Dist.*—Jaunsar : Khalsi ; Gammie, Shaora 5500', C. G. Rogers in the Dūn, common in ravines, at foot of Himalaya, and up to Mussooree, 25-7000'. *T. Garh.*—Ganges Valley 5-6000', Duthie ; *B. Garh.*—Mrs. Fisher ; *Kumaun*—Naini Tāl 7500', Hope 1861 ; Davidson ; Gola Valley, above Ranibagh 2-2500', Hope 1890 ; "very common in all valleys, 2-5000'," MacLeod.

DISTRIB.—*Asia* : N. Ind. (Him.) Sikkim and Bhotan ; Assam—Khasia 2-4500', frequent ; Bengal—Chutia-Nāgpur 2-3000'. Ceylon—Malay Peninsula. S. China. *Afr.* ; *Trop.* ; Mauritius.

Mr. Clarke says—very partial to limestone ; but I find it grows also on sandstone and shale. It flourishes on dry cliffs, in the clefts of which it buries its procumbent rhizome, which has a beautiful covering of long golden-chestnut scales. The sori are rarely nephrodioid, generally looped, or hippocrepiform : towards tips linear. The plant might almost be put in *Althyrum*.

25. *N. Boryanum*, Baker, non Hook. ; Syn. Fil. 284 ; C. R. 527. *Lastrea Boryana*, Willd. (under *Aspidium*), Bedd. H. B. 266.

PUNJAB : *Chamba*—McDonell (in List of Chamba Ferns identified at Kew ; *Kangra Vy. Dist.*—Dharmśāla, C. B. Clarke 1874 ; *Simla Reg.*—Simla, Col. Bates, Dr. Cattell, 10th Hussars, 1876 ; Simla waterfalls, Gamble ; Simla—"the Glen" 6000', Blanford : "not uncommon in well-shaded ravines below 6000'" ; Simla, below Petersfield 5500', in the open, Hope 1886.

N.-W. P. : *D. D. Dist.*—Mussooree ? Duthie, Herschel ; *T. Garh.*—Bhatauli 4-5000', Mackinnons, Hope ; *Kumaun*—Sarju Valley 3-4000', Duthie ; Trotter.

DISTRIB.—*Asia* : N. Ind. (Him.), Sikkim *Hook. fil.*, C. B. Clarke ; Bhotan *Griffith*, C. B. Clarke, *Levinge* ; Assam *Wallich*, Khasia ; Burma—Tonghoo. S. Ind.—Anamallay Hills, *Beddome*. Malaya. China—Yunnan *Henry*. Japan. *Afr.* : Ruwenzori Mt., Scott Elliot ; Johanna, Mauritius, Bourbon.

26. *N. setigerum*, Baker ; Syn. Fil. 284. *N. tenericaule*, Hook., C. R. 528. *Lastrea tenericaulis*, Wall., under *Polypodium*, Bedd. H. B. 266.

PUNJAB : *Chamba State*—Dr. George Watt, *vide* Trotter.

DISTRIB.—*Asia* : N. (Him.), Nepāl, Sikkim ; Assam—up to 4000' : E. Bengal—"very common, extending some way into the plains, as to Sylhet Station," *Clarke*. S. Ind.—on the W. Mts., 2-3000' : "very common," *Beddome* in H. B. Burma. Ceylon 1500'—3000'. Malaya, China, Australia, Polynesia (Clarke, in 'Review').

This species is entered in Trotter's Lists, both printed and MS., and he wrote to me about it, but I do not think I saw the specimen. It is not entered in McDonell's List of Chamba Ferns identified at Kew ; and Blanford did not admit it as a fern of the Simla Region, where Dr. Cattell, in his published list, said it had been got.

#### Subgenus EUNEPHRODIUM.

27. *N. molliusculum*, Wall. (under *Polypodium*), Cat. 332, Bedd. Suppt. H. B. 68. *N. Hopei*, No. 165\* Baker, in Ann. Bot., Vol. V., No. XVIII. *N. molle*, Desv., an E. Indian form of, Syn. Fil. 293. *N. extensum*, vars. *microsora* and *late-repens*, C. R. 529, 530. *N. microsorum*, Clarke, Bedd. H. B. 270.—Plate XXXIV.

N.-W. P. : *D. D. Dist.*—Dehra Dun E., Song R., above Lachiwála 18-1900', Hope 1886 : seen also eastward down to 1150' alt. ; Nála Páni, near Dobra, "23-9 70," in Herb. Hort. Calc. ; *Garhwal*—G. King, 1868 ; *Kumaun*—R. B. 1827 ; A. O. Hume, in Herb. Hort. Calc. ; Kali Valley, 2-3000', Duthie 1884 ; Sarju Valley near Bageswar. 3-3500', Trotter 1891.

DISTRIB.—*Asia*.: N. Ind. (Him.), Sikkim 506'-1000', common ; in the Terai universal (Clarke in 'Review') ; Assam-Kohima 5000', Clarke—as *N. extensum*, in Linn. Journ. XXV, 94. China, *Henry*, No. 13079 : presented to Kew Herb. in 1900 and named there *N. molle*.

Colonel Beddome has given up his *N. microsorum*, and in his Supplement of 1892 has in its stead set up *N. molliusculum*, Wall. Both Baker and Clarke say that Wallich's *N. molliusculum* is *N. molle*, alias *N. parasiticum* ; but on turning up Wallich's specimen in the Linnean Society's Herbarium, I find that Col. Beddome's new view is correct. Mr. Baker had, of course, been obliged to rename the plant, because there was already a *Nephrodium* (*Lastrea*) *microsorum*, Hook., No. 69 in the 'Synopsis.' This re-christening has promoted research.

*N. molliusculum*, though very rare in N.-W. India, seems—if Beddome's reduction of Clarke's varieties of *N. extensum* be correct—to be very abundant in Sikkim and the 'Tarai' below it. Clarke says his var. *microsora* is common in Sikkim, and that his var. *late-repens* is universal in the 'Tarai.' [As this vernacular word had not, I think, appeared in this paper before it may be explained that it means the second belt or zone of land below the Himalaya Range,—the first, just at its feet, being the 'Bhabar' or steepish stratum of boulders and gravel into which the off flow of the mountains sinks—to reappear in the flatter 'Tarai,' at a lower level.] Mr. Clarke says :—"This fern creeps in the sand near streams where they debouch from the hills, covering acres, I might say square miles, of country, as round Siliguri." Again, under *N. procurrens*, he says—"There are ferns, like *N. extensum*, var. *late-repens*, where a single rhizome will cover a quarter of an acre." In the Dehra Dún, the station where I first saw *N. molliusculum* was below the high bank of a river, in swampy ground caused by water trickling out of the bank ; this was in forest, and canes (*Calamus* sp.) were growing in the swamp, which prevented the rhizomes being traced to any great extent. It was evidently a wrong time of year for collecting the fern, and there were large beds of young sterile fronds, among which were found a few larger and more developed fertile fronds of the previous season. I think in July and August good fertile specimens would be got ; but where a fern perpetuates itself so well from its rhizome it has small need for producing sporangia. *Asplenium multicaudatum*, Wall., is another case in point. Dr. King's plant from Garhwál, noted above, seems this ; but the pinnæ dwindle to nothing at the base of the frond. In the Calcutta Herbarium there is a remarkably fringed sport, from Assam, *Simons*.

28. *N. aridum*, Baker; Syn. Fil. 291; C. R. 531. *Nephrodium aridum*, Don (under *Aspidium*), Bedd. H. B. 272. *Aspidium venulosum*, Wall. Cat. 352. *A. scabridum*, Wall. Cat. 302.

PUNJAB: *Chamba*—McDonell; *Kullu*—Upper Beas Valley 5-6000', Trotter 1887; *Simla Reg.*—Bashahr, Lacc.

N.-W. P.: *D. D. Dist.*—Khurrak, Edgew.—Very common in the Dnn, in ditches and by sides of streams, 1500'—3000'; *Kumaun*—Sarju Valley 3500', S. & W., Davidson; near Askot 4-5000', Duthie; Takula 4500', MacLeod. *Oudh*—Philibhit, Keri and Baraitch Dists., Duthie 1898.

DISTRIB.—*Asia*: N. India—"Throughout the Bengal Plain, abundant: from the Soonderbun (Sundriban) to Assam and the Dehra Dun, ascending the hills to 3000'. Throughout India and Ceylon." (*Clarke's Rev.*). Rhotan, *Nuttall*, Manipur 1500', *Clarke* 1885. Not in S. India or Ceylon (*Bedd* in H. B.). Malay Peninsula, Perak and Singapur. N. Australia (*Clarke* in *Rev.*)

This is one of the commonest ferns in the Dehra Dun, where there is water; it is quite a hedgerow plant, if there is a wet ditch adjoining. Its name must have been given to it on account of the dry appearance and texture of the fronds when mature; while growing they are succulent. The rhizome is creeping. I would amend Beddome's description thus:—

"*Rhizome* creeping; *stipes* 1 ft. or less long, erect, slightly pubescent; fronds 2-12 ft. l., 12-15 in. br.; *pinnæ* increasingly distant until below they are 4-6 in. apart, and rapidly diminishing to mere auricles, 6-9 in. l.,  $\frac{3}{4}$ -1 in. br., cut about  $\frac{1}{3}$ rd of the way down into subtriangular sharp-pointed lobes, in the barren fronds, at least, auricled at base above; the lowest lobes of the *pinnæ* sometimes much the smallest, sometimes much the largest, in which latter case the veinlets may be found forked, and anastomosing in the lobe; *texture* coriaceous, glandular below; *rhachis* and lower surface hairy; veinlets 8-10 on a side, 5-6 pairs joined with those of the adjacent pinnules; *veins* in green frond transparent, in dry frond opaque; *sori* in rows, 1 or 1 pair at junction of lowest pair of veins,—the rest nearly medial."

Colonel Beddome's new species, *N. papyraceum*, Suppl. H. B., p. 69, is, I feel sure, non-existent, so far at least as N.-W. India is concerned. His locality—"Kullu, Upper Biso Valley, Trotter"—must be a misprint for "Upper Biás (or Beás) Valley. I have a young sterile frond from Trotter collected in Kullu—Upper Bias Valley 5-6000', noted above, and it is *N. aridum*, pure and simple. It has no such venation in the lowest segments of the *pinnæ* as Beddome speaks of; but on looking at other specimens I find that is a character of *N. aridum*, as long ago I observed it is of *N. mole*. I now understand that Col. Beddome gives up the Kullu station for *N. papyraceum*, admitting that his specimen is *N. aridum*.

29. *N. molle*, Desv.; Syn. Fil. 293; Bedd. H. B. 277. *N. parasiti-*



*rum*, C. B. Clarke, C. R. 533 (Linn. under *Polypodium*; Sunw. der *Aspidium*).

TRANS-IND. STATES : *Swat*—below Laram Pass, 4000', Gatacre 1895.

PUNJAB : *Hazara Dist.*—Trotter in Lists ; Siran Vy., Inayat, collr. for Sahar. Herb. 1896. *Chamba State*—McDonell in List and J. Marten ; *Kangra Vy. Dist. W.*, 25-3000', Trotter ; *Hoshiarpur Dist.*—Aitch. ; *Jalandhar*, Aitch. ; *Simla Reg.*—Simla and vicinity—"not met with above 5000', but common in the deep valleys at 4500' and below": Blanford in List.

N.-W. P. : *D. D. Dist.*—Jaunsar 3000' and lower, common in the Dehra Dún 1-3000' ; *T. Garh.* near Bhatauli 4500', Hope ; *B. Garh.* Mrs. Fisher. *Kumaun*—Almora 4600', Hope ; "Kumaun," Davidson 1875 ; Gola Vy. 35-4000', Hope ; *Gorakhpur Dist.*—Nichaul (in a well), A. Campbell.

DISTRIB.—*Amer.* :—Cuba and Mexico to Peru and Brazil. *Asia* : Himalaya and S. India ; China—Hong Kong. *Australasia* : N. S. Wales and N. Zealand. *Afr.* : Macaronesia, Guinea Coast, Cape Colony, Mascaren Isles.

Mr. Clarke says this species is very little variable, considering its extensive range. There is, or was, close to Dehra a remarkable sport, which besides forking, sometimes several times, has a tendency to become distinctly bipinnate, and when so is often soriferous. Such fronds were found on plants producing also normal fronds ; and the sporting seemed to be luxuriance produced by moist rich soil in a ditch, used also as an irrigation channel, with dense shade overhead. I have seen plants with similar tendency on the slope of a canal cutting near Dehra. I gathered many plants and fronds of this from the first-mentioned station, but never got a frond wholly bipinnate. Had I found a plant with only bipinnate fronds, I might have been tempted to propose a new genus or subgenus—there being no bipinnate *Eunephrodium* that I know of. In the Calcutta Herbarium there is a specimen of a similar sport from Sikkim, 1873.

30. *N. papilio*, n. sp.—Plate XII. (see Part II., Vol. XII., p. 625).

Add, to localities :—*T. Garh.*, Mantargadh 4500', Gamble, 27413, 10-98 ; *B. Garh.*, Mrs. Fisher.<sup>3</sup>

31. *N. occultum*, n. sp.—Plate XIII. (see Vol. XII., p. 627).

Subgenus *SAGENIA*, Presl.

32. *N. cicutarium*, Baker ; Syn. Fil. 299 ; C. R. 539. *Aspidium cicutarium*, Sw., Bedd. H. B. 220.

PUNJAB : *Chamba State*—McDonell, in List ; *Kangra Vy. Dist. W.*—8000', Trotter ; *Mandi State*, Trotter 1887 ; *Simla Reg.*—below the tonga road, 8 miles from Simla, Bliss 1892 : new to the Region ; not in Blanford's List.

N.-W. P. : *D. D. Dist.*—The Dehra Dún and South slope of Himalaya, 15-5100', common ; *T. Garh.*—Ganges Vy. 3-4000', Duthie ; *B. Garh.*, Mrs. Fisher. *Kumaun*—Valley of the Sarju 4,000', R. Blink., in Herb. Wallich, 3500', S. & W. ; Naini Tál, Hope 1861 ; Davidson 1875 ; Káli Vy. 3-4000', Duthie 1884 ; Gola Vy. 2500' Hope 1890.

DISTRIB.—*Amer.* : Cuba and Mexico, southward to Brazil and Peru. *Asia* : N., Ind. (Him.), Sikkim and Bhotán ; Assam ; Bengal—Chittagong, Chutia-Nágpur

1-4000', common. S. India—"the more hairy variety, known as *coadunata*, only is found" (Bedd. H. B.); Burma. Ceylon. Afr.: Guinea Coast, Angola, Zambesi Land, Mascaren Islands.

No mention is made in the Synopsis of Clarke's *var. coadunata*, Wall. Cat. 377, partly:—"Frond thick, hairy on the rhachises, and often on the frond beneath," which he says is as widely spread in North India as the typical *N. cicuterium*, and still more plentiful. I have seen no such hairy *Sagenia* from N. India, or indeed from elsewhere. Clarke goes on to say that *N. coadunatum* is a stout, firm, thick hairy frond on a short stipe, but that Wallich's type sheet of *Aspidium coadunatum* is very glabrous, and is unfortunately exactly that variety which has been known in India as not *var. coadunata*!

I have a specimen of this fern from Simla, a portion of a thin, light-green, membranous frond, with small sori confined to the long, pointed lobes, and scarcely a trace of involucre; and involucre are hardly visible in a large specimen from below Mussooree. On the other hand, in one specimen received from the Messrs. Mackinnon, collected near Mussooree, the involucre are persistent, but only  $\frac{1}{16}$ th in. diam.; while in another, from the same source, they are  $\frac{1}{8}$ th in. diam., and so crowded all over the frond as often to overlap one another: their diameter is thrice that of the sorus, and they are all nephroid. A specimen I collected at 5100' alt., below Mussooree, is mounted on five  $18\frac{1}{2}$  in. sheets: the second lowest pinnæ are 22 in. l., giving a breadth of frond of 44 in., and the lowest pinnæ are  $24'' \times 12''$ , and  $26\frac{1}{2}'' \times 13''$ , respectively. Some American specimens are comparatively small, and not broad below.

Genus 24. NEPHROLEPIS, Schott.

1. *N. cordifolia*, Presl.; Syn. Fil. 300; C. R. 540; *N. cordifolia*, Linn. under *Polypodium*, Bedd. H. B. 282.

N.-W. P.: *T. Garh.*—below Laluri 3-4000', Duthie 1881; *B. Garh.*—3-4000', P. W. Mackinnon 1881; Kinoli Vy.—4-5000', Duthie 1885. *Kumaun*—Sarju Vy., near Bagesar 3-3500', S. & W. 1848, Trotter 1891; Sarju—Ganga Vy. 3500', MacLeod 1893.

DISTRIB.—*Amer.*: Cuba and Mexico to Brazil and Peru. *Asia*: N. Ind. (Him.), Bhotán, up to 5000'; Bengal—Chittagong, as well as on the hills to the south of Hindostán. S. India. Ceylon. Burma. Malaya. Japan. Australia and N. Zealand. *Afr.*: Guinea Coast, Zambesi Land and Mascaren Islands.

2. *N. volubilis* (J. Smith), Clarke in 'Review' 541, t. 78; Bedd. 284. *N. exaltata*, Schott, Syn. Fil. 301: "a straggling, flexuose form." Mr. Clarke's description is:—

"Rhizome climbing 25—30 ft. high over trees, with adpressed chestnut scales in the short lateral distant spurs, whence spring clusters of stipes; pinnæ obtuse or not very acute; venation and sori much as in *N. exaltata*. *Aspidium exaltatum*, Wall. Cat. 1031, partly marked *vir exultatum* by Wallich. *Lindsaya laurcinosa*, Wall. Cat. 154.

N. W. P.: *Kumaun*—Naini Tál, Hope 1861; once seen.

DISTRIB.—*Asia* : N. Ind. (Him.), Bhotán *Griffith* ; Assam—Sylhet Station (alt 300'), *Hook. fil.* and *T. T.*, and *C. B. Clarke*, Manipur ; Bengal—Chittagong, *Hk. fil.* and *T. T.*, and *C. B. Clarke*. Malacca. Malay Archipelago. N. Borneo.

Mr. Clarke says in his 'Review,' "Considered a variety of *N. exaltata* in *Hk.* and *Baker*. Syn. Fil. 301 ; but with the arrival of more material Mr. Baker inclines to admit it as a good species. They both grow together plentifully in Sylhet Station, but are there easily distinguished."

*N. exaltata* does not appear to climb at all, whereas *N. volubilis* climbs 25--30 feet (Beddome says 50 feet) to the tops of trees. (Perhaps the specific name *exaltata* is thought sufficient to cover this notable difference of habit : if a fern named *exaltata* does not climb 30 or 50 feet high, it certainly ought to do so.) My specimen from Naini Tál, in Kumaun, consists of eight inches of glabrous, wiry, rhizome, with two spurs, three inches apart, from which spring not-only clusters (pairs) of stipes as in Mr. Clarke's figure, but also clusters of very long roots, which have hardly been indicated by Mr. Clarke's artist. I gathered it by the side of the path (or road) which then (1861) led up Chinara Mountain, through the jungle at the north end of the Naini Tál Glen. The plant was growing on the ground, and I gathered only the portion above described. I showed this to Mr. Clarke and Mr. W. S. Atkinson in Calcutta in 1872, and they agreed in naming it *N. ramosa*, Moore,—in error, as I afterwards saw. The specimen was mounted, with the rest of my collection, when I was at home later in 1892, and the sheet has ever since been in my possession.

Genus 25. OLEANDRA, *Cav.*

1. *O. Wallichii*, *Hook.* ; Syn. Fil. 302 ; *O. Wallichii*, Presl., C. R. 542 ; Bedd. H. B. 287.

PUNJAB : *Simla Reg.*—Simla 5-6000', Edgeworth, Bates, Gamble, Blanford, Trotter, Bliss. "Not common, but locally abundant : growing on perpendicular rock faces between 5500' and 6000'," Blanford in List.

N.-W. P. : *D. D. Dist.*—Mussooree, in Herb. Dalziel, 1860 ; "The Park" 63-6500', on trees, Mackinnon 1879, Hope 1887, 1895 ; *T. Garh.*—Jumna Vy., Duthie 1883 ; "Garhwál," 5-6000', Dr. J. L. Stewart, *B. Garh.*—above Bansbagar 4-5000' and 6-7000', Duthie 1885 ; *Kumaun*—Mabargiri 6500', S. & W. 1848 ; near Nafni Tál, Hope 1861, on wet rocks ; Gori Valley 5-8000', Duthie 1884, 8-9000', Duthie 1886 ; Dhankuni Pass 8500', Trotter 1891 ; Kála Muni Ridge 9000', MacLeod 1893 ; "grows chiefly on rocks, occasionally on trees."

DISTRIB.—*Asia* : N. Ind. (Him.), Nepál, *Wallich*, Sikkim and Bhotán ; Assam—Khasia, Kohima and N. Manipur 5500'. Burma, Malay Penins.

The fronds of this fern grow larger than is stated in the books : I have Mussooree specimens over 18 in. l. The creeping rhizome is generally free, only clinging to the trunks of trees and to rocks by its long wiry roots : it winds round and up the trunks, branching in all directions—frequently at right angles. The fronds droop, and form a beautiful clothing to the tree trunks.



## THE FERNS OF NORTH-WESTERN INDIA.

Including AFGHANISTAN, the TRANS-INDUS PROTECTED STATES, and KASHMIR: arranged and named on the basis of Hooker and Baker's *Synopsis Filicum*, and other works, with New Species added.

By C. W. HOPE.

(Continued from page 749, Vol. XIV.)

## PART III.—THE GENERAL LIST—(continued).

## Genus 26.—POLYPODIUM, L.

## Subgenus PHEGopteris, Fée.

1. *P. erubescens*, Wall. ; Syn. Fil. 306 ; C. R. 543. *Phegopteris erubescens*, Wall. (under *Polypodium*), Bedd. H. B. 289.

KASHMIR: Basaoli, 5500', Clarke 1876 ; MacLeod 1891 : " mouth of gorge near 30th milestone, in very wet soil, 6-8000'."

PUNJAB: *Hazara Dist.*—Siran Range, coll. Inayat, Sahar. Herb. collr. 1899 ; *Chamba State*, McDonell, J. Marten 1898, *Kullu*—6-8000', Coventry 1894 ; *Simla Reg.*—Edgeworth, Bates : near Simla 5-6000', and Mashobra 7-8000', Blanford : " at the bottom of some of the deep valleys below Simla, where it is pretty common. My highest elevation is about 5500' " ; Sirmur, T. Thomson.

N.-W. P. : *D. D. Dist.*—Jaunsar 4500', C. G. Rogers ; Mussooree 4-6000', by water, not uncommon ; *T. Garh.*—Phedi 4-5000', and below Laluri 3-4000', Duthie ; *B. Garh.*—Mrs. Fisher ; *Kumaun*—R. B. 1827, Wallich type specimen ; Ramganga R. and Karim 6200', S. and W. 1848 ; Naini Tāl 55-6000', Hope 1861 ; Davidson, Trotter ; ridge above Bageswar 6000', MacLeod 1893.

DISTRIB.—*Asia* : N. Ind. (Him.), Nepāl, Wallich Sikkim ; Assam—Khasia 3-7000', " somewhat rare." Malay Penins. and Isles. China—Yunnan, *Delavay* 1886.

Lowest pair of pinnae deflexed. Stipes and rhachises not always pink : sometimes pale-yellow or straw-coloured. Grows in wet ground below springs, or by the sides of streams—the fronds bending over the water, and attains a large size, 10 ft. long, including the long stipes—if my memory serves me rightly as to Naini Tāl specimens. A Chamba specimen has pinnae  $13\frac{1}{2}$  in. l. by  $1\frac{1}{8}$  br. It grows 8 ft. high in Mussooree.

2. *P. auriculatum*, Wall. ; Syn. Fil. 306 ; C. R. 543. *Phegopteris auriculata*, Wall. (under *Polypodium*), Bedd. H. B. 290.

PUNJAB: *Chamba State*—McDonell ; *Simla Reg.*—Edgeworth ; near Koti 6000', Gamble 1878 ; Sámál Vy. (below Simla) 4500', Blanford : " very rare in the neighbourhood of Simla. I have met with it but once " ; Simla—several stations, 57-6000', Bliss 1890-91 and 92.

N.-W. P. : *D. D. Dist.*—Mussooree, King, in Herb. Hort. Sahar. ; *B. Garh.* 4-5000', Duthie 1885 ; *Kumaun*—Naini Tāl, Hope 1861 ; Goriganga Vy. 6500', MacLeod 1893, pinnae very narrow : " grows almost in beds of streams, in dense shade."

DISTRIB.—*Asia* : N. Ind. (Him.), Nepāl, Wallich 1821 ; Sikkim and Bhotán, 5-8000' : " plentiful about Darjeeling " ; Assam—Khasia 5000', Hook. fil. et T. Thomson. Java : *vide* Clarke. China—Yunnan, Mengtze 6000', *Henry*.

A specimen collected by Mr. Bliss at Simla is 16 in. br. with pinnae  $1\frac{1}{2}$  in. wide,  $1\frac{1}{4}$  in. nearest rhachis, veinlets 12—14 of a side, up to 17 in lowest segments, forked in lowest, and occasionally so in next above. In this species the sori are considerably nearer the costa than the edge.

3. *P. Phegopteris*, L. ; Syn. Fil. 308 ; C. R. 544. *Phegopteris vulgaris*, Mett., Bedd. H. B. 290.

TRANS-IND. STATES : *Dir.*—Mirga 9500', Surg.-Lt. S. A. Harriss, 1895.

KASHMIR :—Tajwas Nāla, 11-12,000', Levinge 1872-75 ; Dr. Aitchison 86-10,000' ; Sarpat 10,000', MacLeod ; Gulmarg 8-9000', Duthie.

PUNJAB : *Chamba*—Pāngi 8000', McDonell 1882 ; Upper Chenāb Vy. 8000' (in Kashmir ?), Baden Powell 1879 ; "Chamba" J. Marten ; *Pa'ngi*—Sānch Vy. 8500', Harsukh (Sahar. Herb. collr.) 1899 ; *Lahaul*, Dr. G. Watt.

N.-W. P. : *T. Garhwal*—Banga Pāni 10,000', and Kidarkanta 10-11,000', Duthie 1879 ; *Kumaun*—between Milain and Rilkot 10,000', MacLeod 1893.

DISTRIB.—*Amer.* : Greenland to Alaska, Labrador, Newfoundland, and Canada ; *U. S.* : New England to Virginia and westward ; *Europe* : Iceland, Scandinavia and British Isles to Spain, N. Italy and Greece, and intervening regions ; *Caucasus*. *Asia* : N. Ind. (Him.), Sikkim—Sundukphu 11,500' Levinge. *Siberia*, *Mandschuria*, *Kamchatka*, and *Japan*.

4. *P. distans*, Don ; Syn. Fil. 308 ; C. R. 544. *Phegopteris distans*, Don (under *Polypodium*), Bedd. H. B. 292.

KASHMIR : ?

PUNJAB :—*Chamba* ? *Simla Region* ?

N.-W. P. : *D. D. Dist.*—Jaunsar, Chakrāta 7000', Gamble No. 22,825, 1891 ; *Kumaun*, near suspension bridge on old road to Almora, Hope 1861.

DISTRIB.—*Asia* : N. Ind. (Him.), Nepal, *Wallich* ; Sikkim, *C. B. Clarke* : typical ; *Assam*—*Khasia*, *Simons*. *Malay Peninsula*. *Java*. *China*.

As both Clarke and Beddome say, *P. distans* has tufted stipes, and—as in all Gamble's specimens from Sikkim and Chittagong—16 sheets—which are complete, the caudex is erect with tufted stipes, and as this is the character of some thirty specimens in the Calcutta Herbarium, I have separated the numerous specimens from N.-W. India, hitherto called *P. distans*, but which have a widely creeping and branching rhizome, and I give them as a new species—*P. late-repens*, next below. I am doubtful about the Kashmir specimens which I have not seen except Trotter's, which we agreed are *late-repens*, and also about McDonell's from Chamba. Gamble's, and some of Blanford's, specimens from the Simla Region have erect caudices, and so have Gamble's from Jaunsar in the Dehra Dún District. The Kumaun specimens have the caudex rather decumbent and stipes subtufted, but are otherwise the same.

Generally speaking, *P. distans* seems to be a smaller, stiffer, narrower, and less cut fern than the next, but occasionally the fronds are broad for their length. This is so with a specimen from Sikkim, coll. King, No. 4132, 1877, which Sir George kindly sent me in 1890, as a type of Don's plant. That frond is

14 inches broad. The stipes are very erect, closely set, and densely scaly for some way up. The pinnae are cut down  $\frac{3}{4}$  or  $\frac{4}{5}$ ths to the rhachis, and the segments are entire, or very slightly crenate at the apex. Don's description in the Prod. Fl. Nepal is :—

“*P. distans*, fronde lanceolatâ—pinnatâ : primus distantibus suboppositis lanceolatis acuminatis altepinnatifidis pilosiusculis ; segmentes oblongis apice rotundatis ; imis inciso-serratis ; superioribus repandis, stipite rhachique semi-terribus villosis, soris remotis biserialis.

“Hab. in Nepaliæ alpinis, Wallich. Frons bi—v. tripedalis. Rhachis purpurascens.”

There is no allusion to a rhizome in the above. Mr. Duthie once kindly noted down for me the localities and collector's names of the (Indian?) specimens named *P. distans* in the Calcutta Herbarium ; and I grouped them in five forms, thus :—(1) *Typical form*, from Simla, *Gamble* ; Sikkim, Khasia, and Nilgiris ; (2) *var. minor*, *C. B. Clarke*, from Sikkim ; (3) *var. glabrata*, *C. B. Clarke*, Kumaun, *R. Blinkworth*, without rhizome, named *P. brunneum* Wall. on original ticket : margins of segments almost entire ; (4) *var. paludosum*, from Labaul, Khasia, Nilgiris *Gamble*, and Ceylon,—rhizome erect, stipes tufted ; and (5) *var. adnata* (sp.) Wall., from Dharmasala *Edgeworth*, Chamba *C. B. Clarke*, Garhwal 8000' *Blanford*, Nepal, Nilgiris *Beddome*, Ceylon *Thwaites*. Mr. Duthie noted that there were no type specimens of Don or Wallich, except a doubtful one of each ; and that the specimen ascribed to Don looked very different from the rest of *var. adnata*, the margins of the segments being almost entire.

5. *P. late-repens*, n. sp., (Trotter MS.) *Hope* Plate XIV. (see Vol. XII., p. 628).

*Add.*—for Jaunsar hab—Molta Range 6060', Duthie 1896 ; *B. Garh.* Mrs. Fisher : pinnules entire, only toothed at points : no stipes present. *Kumaun* : Inayat, nat. collr. Sahar. Herbarium, No. 25,088, 8-1890.

6. *P. Dryopteris*, L., including *P. Robertianum* Hoffm.; Syn. Fil. 309; C. R. 545. *Phegopteris Dryopteris*, Linn. (under *Polypodium*), Bedd. H. B. 293.

AFGHAN : Kurram Vy., Aitch. 1879 ; Peiwās Kotal, Collett 1879.

TRANS-IND. STATES : *Baraul*—Mirga 7500', Gatacre 1895 ; *Chitral*, J. E. Younghusband 1894.

KASHMIR : 7-13,000', frequent ; Gilgit—Toltion Indus, 5000', Winterbottom 1847.

PUNJAB : Hazara Dist.—Kagān Vy., Inayat (Sahar. Herb. collr.) 1896 (probably *P. Robertianum*) ; Chamba State 7-8000', McDonell, J. Marten, 1882 to 1899 ; Kangra Vy. Dist. 8000', Harsukh (Sahar. Herb. collr.) 1899.

N.-W. P. : *T. Garhwal*—Ganges Vy., 8-11,000' Duthie ; *B. Garh*—Dombitā Gadh 9000', Duthie ; *Kumaun* 10-13,000', Duthie, Trotter, MacLeod.



DISTRIB.—*Amer.* : Greenland and Sitka to Rocky Mts., Canada and Newfoundland ; *U.S.* : N. E. States to Virginia, and westward to Oregon and Alaska. *Europe* : Widely distributed, from the extreme north to Italy and south of Spain. *Asia* : Seberia and Kamschatka. China—Peking Mts. 5000', *Hancock* : "very rare"; Mukden—Kirin, *James*.

I have marked some of the specimens enumerated above *P. Dryopteris*, and others *P. Robertianum*, but there are others I am not sure about. I think the difference between the two plants is not so great as it is in Great Britain. I agree with Mr. Clarke that if *P. Robertianum* is distinct it grows in the N.-W. Himalaya.

7. *P. ornatum*, Wall. Cat. 327 ; C. R. 545. *Phegopteris ornata*, Wall. (under *Polypodium*), Bedd. F. S. I., t. 171, H. B. 294.

N.-W. P. :—*Kumaun* : *vide* Clarke in 'Review.'

DISTRIB.—*Asia* : N. Ind. (Him.), Sikkim and Bhotán, in tropical valleys 0-2000', common ; Bengal—Chittagong Hills 500', S. Ind.—Carcoor Gháts, Malabar, and elsewhere along the Western Ghats, but not common—*de* Beddome. Ceylon. Malaya. N. Australia. Polynesia.

I enter this species on Mr. Clarke's authority, but I do not think it can be common in Kumaun, as he seems to say, for none of my correspondents seem to have found it there. I have not myself collected in the low-lying valleys of Kumaun, except in that of the Gola, from about 2000' upwards, and I did not see it there.

8. *P. punctatum*. Thunb. ; Syn. Fil. 312. *P. rugosulum*, Labill., C. R. 546. *Phegopteris punctata* Thunb. (under *Polypodium*), Bedd. H. B. 295.

PUNJAB : *Chamba*, McDonell, J. Marten ; *Kullu*—Trotter, in list ; *Simla Reg.* : Asan Valley, Edgeworth 1840 ; seen, freshly gathered, by Hope, 1886—said to be from Rifle Range, E. of Jako Mt. 6-7000' : not in Blanford's List and not got by Bliss.

N.-W. P. : *D. D. Dist.*—Jausar, Lakhwa 3-4000', Gammie ; Chatra 6000', Gamble ; *T. Garh.* 4-5000', Herschel, Mackinnons Hope, Duthie ; *Kumaun* T. T. 1845, S. and W. 5-7000', Duthie, Trotter, MacLeod.

DISTRIB.—*Amer.* : Columbia to Chili. *Asia* : N. Ind (Him.), Nepal *Wallich* ; Sikkim and Bhotan ; Assam—Mishmi *Griffith*, Khasia *T. Lobb*. Bengal—Chittagong, alt. 1000'—5000'. S. Ind., common on W. Mts. at high alts. Ceylon, Malay Penins. Tonkin. Java. Philippines. Japan. Sandwich Isles. N. Caledonia. Moluccas. Australia. N. Zealand. Van Dieman's Land. *Afr.* : Fernando Po 7000'. Tristan da Cunha St. Helena. Bourbon. Madagascar.

Subgenus GONIOPTERIS, *Presl*.

9. *P. urophyllum*, Wall. Cat. 299 ; Syn. Fil. 314 ; C. R. 547. *Nephrodium urophyllum*, Wall. (under *Polypodium*), Bedd. H. B. 274 and Sappt. 72.

N. W. P. : *Garhwal* and *Kumaun*, *vide* Clarke in 'Review.'

DISTRIB.—*Asia* : N. Ind. (Him.), Sikkim and Bhotan ; Assam—Khasia ; Bengal—Chittagong. Burma. Ceylon. Malaya. New Hebrides—Aneiteum. *China* : Chusan Polynesia. N. Australia. Queensland.

I have not seen the specimens from the west of Nepal on which Clarke founds, nor any others from N.-W. India.

10. *P. proliferum*, Presl.; Syn. Fil. 315. *P. proliferum* (Roxb.) Wall. Cat. 312, U. R. 548. *Goniopteris prolifera* Roxb., Bedd. H. B. 296. *Menisium proliferum* (Sw.) Hook 2nd Cent.

KASHMIR: 3000'; Trotter in List.

PUNJAB: *Chamba*—McDonell in List; near Dalhousie 3000', Trotter, *Kangra Valley Dist.* 2-3000', Trotter.

N.-W. P.: *D. D. Dist.*—Very common in the Dún, on banks of streams and canals, up to perhaps 3000'; *T. Garh.* 1500', *Hope*, 3000' Mackinnons; *Saharanpur Dist.*—Roorkee, Lt. Sedgwick, R.E.; *Kumaun*—The Bhabar 1000', S. and W.; Gonai, Davidson, above Katgodam—below 2000', Hope; *Gorakhpur Dist.*—Sirna Tal, on banks of Rohni R: had been submerged 11ft. by a flood, A. Campbell; Moradabad, T. T. 1844; North Oudh Forests, R. Thompson.

DISTRIB.—*Asia*: N. Ind.—eastward in the plains, and westward along the foot of the hills up to 3000'; Chutia Nagpur, *Rev. A. Campbell*; Central Provs., Hoshangabad Dist., *Duthie*; The Concan, *Law*. S. Ind.; Ceylon—Trincomalee, *Wight*; Burma—Mergui, Malaya S. China, Philippines. N. Caledonia. N. Australia. S. Australia—Queensland. New Guinea. *Afr*: Angola. Zambesi Land. Shire—near Blantyre; E. Trop. Africa. Mauritius. S. Africa.

As I find none of the published descriptions of this species sufficient. I venture the following, which is founded on long observation of growing plants:—

*Rhizome* stout, slowly creeping and branching. *Fronds* springing sometimes in tufts, procumbent, or climbing among bushes and in hedgerows: sometimes of definite length, broad, spreading, and sterile, but one or more fronds of a tuft having a leading prolonged rachis which throws off branches from buds at the axils of the pinnae 3-6 inches apart, up to 6 branches per bud, and, if trailing on the ground, becomes an epigeous rhizome, throwing out roots as well as branches from the axils, but ultimately diminishes in width and becomes flagelliform: the side branches fertile, and often prolonged, sending out one or more branches from each bud as does the main rachis: the main flagelliform rhachis often fertile to the apex. (*Quoad ultra—vide auctores*).

Some of my observations were made on plants naturalised in my garden in Dehra (N.-W. P.), transplants from a closely adjoining natural station. Given moisture and other favourable circumstances, this species is capable of great development: I believe lateral shoots sometimes become leaders. Beddome is certainly wrong in saying that the elongated and flagelliform fronds are "non-seeding," as specimens in my collection show.

11. *P. lineatum*, Colebr. in Wall. Cat. 300; Syn. Fil. 316; C. R. 548. *Nephrodium costatum*, Wall. (under *Polypodium*), Bedd. H. B. 275 and Suppt. 73.

KASHMIR: Tawi Vy. 4000', Levinge 1875; Trotter, in MS. List; Jhelam Vy. "35th Milestone," MacLeod 1891.

PUNJAB: *Chamba State*—McDonell in List; Chamba 5000', Blanford, Trotter; *Simla Reg.*—Simla 5500', Bates, Gamble, Bliss; Sirmur—T. T.

N.-W. P.: "N. W. I.", very red, Falconer; *D. D. Dist.*—Mussoorae 4-6000' by streams and in swampy ground, not uncommon, Herb. Dalzel, King, Mackinnons, Duthie, Hope; *T. Garh*—Mackinnons, Duthie 4-5000'; *B. Garh*—Mrs. Fisher; *Kumaun*—Wallich; Phurka and Bagesar 3500', S. and W. 1848; Col. Davidson 1875 (very red); Nalena Vy. 47-5000', Hope 1890 (only slightly red); near Bagesar 3000', Trotter 1891.

DISTRIB.—*Asia*: N. Ind. (Him.) Nepál, Wallich 1827; Assam—Mishi, Griffith, Khasia, Silhet, Ceylon, Penang, China-Centr., Mr. Maries; Ichang, Henry; *Szechwan*: Mt. Omei, Faber; *Yunnan*: Mengtze, Hancecock.

A very different looking plant from the next, and much more elegant. The rhizome is widely creeping, never erect. By the side of running water it grows to a large size. I have a frond I gathered in Kumaun, mounted on five 18½" sheets, with stipes almost 30 in. and frond 57 in. l., and I got others larger. Mr. J. W. Furréll has seen fronds, 8 ft. long, without stipe. As is often the case with ferns having a creeping rhizome, many fronds are sterile, but otherwise the same as the fertile fronds. I have never seen any trace of involucre on even very young fronds gathered in N.-W. India. Beddome says specimens from Dr. Stuart, Garhwál, have the involucre very distinct. Clarke, who kept the species in *Polypodium* (*Goniopteris*), says the young sori have many hairs among them.

The stipes, rhachises and veins are often quite red. The number of veins runs up to 10 pairs, the excurrent venule being often free. Beddome, in his supplement, says the rhizome is sometimes creeping, sometimes erect. I find it is always widely creeping. Beddome may have mixed up two distinct ferns; and I cannot admit that a fern can be so inconsistent in its structure and habit as he says this is.

12. *P. multilineatum*, Wall.; Syn. Fil. 316; C. R. 547. *Nephrodium moulmeinense*, Bedd. H. B. 275, F. B. I., t. 231.

KASHMIR: Poonch 3000', Major Sage: *vide* Trotter in printed List.

N. W. P.: *D. D. Dist.*—in the Dún, Nalota Khála about 2500', Hope 1880-87-89; Ramgarh Road 2000', Gamble 1892; below Mussooree, to westward, 4000', Mackinnons 1878; Biráni Nadi, Duthie 1882; B. Garhwál, Mrs. Fisher; *Kumaun*, Almora, Davidson 1875; Kali Vy. 2-3000', Duthie 1884; Gola Vy. 2500', Hope 1890; Sarju Vy., near Bagesar, 3000' S. and W.; 3-3500', Trotter 1891. *North Oudh* Forests, R. Thompson.



DISTRIB.—*Asia* : N. Ind. (Him.), Sikkim and Bhotàn ; *Bengal* : Chittagong and plain westward, and ascending the Himalaya to 4-5000', Parasnàth Mt. *Rev. A. Campbell* ; *Assam*—*Wallich* 1829 ; all over the Province ; Nambur Forest, *Mann. S. Ind.* : Golconda Hills, west of Vizagapatam, 2-3000', "involucre distinct" ; not on Western Mts., *Beddome* in H. B. *Burma* : "very common near Moulmein, involucre distinct", *Beddome*. *Fiji Isles*, Seeman ?

Under *P. lineatum*, Baker remarks—"Seems not distinct from the next,"—but see my remark above as to the contrast between the two. The present plant is more coriaceous, and very dry-looking, with veins very prominent and distinct : the fronds are generally broader and shorter, and have fewer pinnæ than *P. lineatum* has,—4-15 pairs in Gamble's and my specimens ; whereas in our *P. lineatum* the number varies from 8 to 30 pairs, only 3 specimens having less than 16 pairs. A specimen I have, from Parasnàth Mt. in Bengal, is 7'-6½" high from the rhizome, of which total the stipe is 44½ inches, and the frond 46. It has only 14 pairs of pinnæ : the lowest are 10 in. l., the next pair 12", and above that there are several about 13 in. The width of the broadest is barely above 1½ in. The pinnæ of *P. multilineratum* are much the broader, and the number of pairs of veins runs up to 23 and even 25. Trotter's plant from Kumaun has the narrowest pinnæ of any I have seen—¾ in., but it nevertheless has 16 pairs of veins. My Kumaun specimens were growing in a swampy slope in forest : very few fronds were fertile. As *Beddome* added in his supplement, the rhizome is creeping : the stipes are distinct.

Blanford, in his published List, gives Simla as a habitat, saying :—"The Glen' and some other wooded ravines below 6000'. The pinnæ are narrow." I think this must be *P. lineatum* Colebr. His specimen of *P. lineatum* from Chamba is marked by him *P. multilineratum*, and yet has the narrowest pinnæ of any *lineatum*, I have seen, with only 6-7 pairs of veins. Trotter says he collected *P. multilineratum* in Chamba and Simla ; and if he is right as to Major Sage's specimen from Kashmir this is probable enough ; but the evidence I have seems insufficient.

I have never seen the slightest trace of involucre in this fern, as growing in N.-W. India ; but I detected some in Gamble's specimens from the Palkonda Hills in the Vizagapatam District, 2560', and the Rumpa Hills, 2000', in the Godavery District, Madras Presidency. The Rumpa Hills' plant has pinnæ cut down about ½ of the half width (½ in terminal pinnæ), segments wider than in other *P. multilineratum*, and not more than 13 pairs of veins, which curve upwards ; and the sori are at a distance from the costa instead of near it ; they are much nearer the excurrent veinlet. These Madras specimens may be the same as the Moulmein plant, which I have not seen ; and I suspect *Beddome* may be right in setting up *N. moulmeinense*, but wrong in upsetting *P. multilineratum*. In his supplement of 1892 he says that fronds of *N. moul-*

*meinese* lately received in a very young state show ciliated involucre on almost all the sori; and that Mr. Mann's specimens from the Nambur Forest, Assam, have the pinnae  $2\frac{1}{2}$  inches broad.  $1\frac{5}{8}$  in. is, I think, the broadest I have of *P. multilineatum*.

Subgenus EUPOLYPODIUM.

13. *P. subfalcatum*, Bl. ; Syn. Fil. 328 ; C. R. 449, Bedd. H.B. 314.

N.-W. P.—*B. Garh.*, Mackinnons 1882 ; *Kumaun*—Kalimundi 8500', S. and W., No. 19 ; *P.* part of Wall. 310 ; named *P. subfalcatum* by Sir W. J. Hooker. Above Gini 6-7000', near Sosa 9-10,000', Duthie 1884. North India, Edgeworth, *vide* Hooker.

DISTRIB.—*Asia* : N. Ind. (Him.) Nepál, *Wallich*, Centra' Nepál, *J. Scully* 1880. Sikkim and Bhotán, common ; Assam—Khasia 4-5000', frequent. S. Ind.—Nilgiris and Anamallays 4-5000'. Ceylon—Centr. Prov. Malay Penins. 3-4000', and Isles. Philippines, *Cuming* ; Borneo ; Moluccas—Batjan Isd. ; New Guinea, *Beccariet*.

Subgenus GONIOPHLEBIUM, Bl.

14. *P. amœnum*, Wall. ; Syn. Fil. 341 ; C. R. 550. *Goniophlebium amœnum*, Wall. (under *Polypodium*), Bedd. H. B. 317.

PUNJAB : *Chamba*, McDonell ; 5-8000', J. Marten 1897 ; *Kangra Vy. Dist.* 8000' ; *Kullu* 6-8000', Trotter, Coventry ; *Simla Reg.*—Simla and neighbourhood, and eastward along Thibet Road to Bisahir, 6-9500', T. T., Edgeworth, Bates, Hope, Gamble, Blauf, Trotter, Bliss, Lace ; Sirmur, T. T.

N.-W. P. : *D. D. Dist.*—Jaunsar, Dakera 5500', C. G. Rogers, Harianta 8500', Gamble 1898 ; Mussooree—'The Park' Hope ; Landour—Seal's Hill 7000', Hope ; *T. Garh.* Nág Tibá Mt. 9000', Mackinnons ; Ganges Vy. 7-8000', Duthie, Datuní 7000', Gamble ; "Garhwál," Grimth 1845 ; *B. Garh.*, Mrs. Fisher ; *Kumaun*—Kathi 7500', Jagesar 6000', S. & W., near Naini Tál 5500' Hope ; above Ramgarh 7000', Trotter ; Kála Muni Ridge 9500', MacLeod.

DISTRIB.—*Asia* : N. Ind. (Him.) Nepál, *Wallich* ; Sikkim and Bhotán ; Assam—Khasia Dist. 3-6000', very common ; Manipur *G. Watt*. China, *Henry*, *Hancock* ; Formosa (doubted by Clarke) Tonkin, *Balansa*.

Mr. Clarke can distinguish this fern from some large specimens of *P. lachnopus* Wall. (No. 15 below) only by the scales (on rhizome ?) not being hair-pointed : he says there is no difference between the two, and he has *P. lachnopus* exceedingly large. One does not need to look at the scales to distinguish between the two species. *P. amœnum* has a broadly lanceolate frond—twice to thrice, rarely more—as long as it is broad : *P. lachnopus* is linear-lanceolate, commonly six to seven times as long as broad, and rarely is the breadth so much as one-fifth of the length : 15 in. l. by 2 in. broad are common dimensions, and I have a frond 21 in. by 3 in. The number of pinnae (or lobes) in the two species is considerably different : in *amœnum* it is sometimes less than 20, generally 25-30, and very rarely reaching 25-40 ; in *lachnopus* the number is rarely below 30, and frequently reaches 45 or more. In *amœnum* the costæ of the segments are from  $\frac{5}{8}$  in. to  $1\frac{1}{4}$  in. apart, and the segments gradually taper from a broad base to a generally very fine point : in *lachnopus* the costæ are generally

about  $\frac{3}{8}$  to  $\frac{7}{16}$  in. apart, rarely  $\frac{1}{2}$  in. or over, and the segments suddenly taper at about two-thirds of their length. The fronds of *lachnopus* are much weaker and thinner than those of *amœnum*, and they hang perpendicularly from the trees they grow on. I have rarely seen *P. lachnopus* on rocks. *P. amœnum* generally, I think, grows on rocks, or in soil on rocky slopes, sometimes standing upright; but in Mussooree I have seen it on trees. When in a young state the fronds are very pubescent, and always there are numerous small chaffy scales on and near the rhachis on the under side. The fronds of *P. lachnopus* are all but naked.

15. *P. lachnopus*, Wall.; Syn. Fil. 342; C. R. 551. *Goniophlebium lachnopus*, Wall., Bedd. H. B. 319.

KASHMIR: *vide* Clarke, in 'Review.'

PUNJAB: *Kullu* 5-7000', Trotter in printed List; *Simla Region*—Simla, Edgeworth 5-5500', Gamble, Blanford, Trotter, "not very common"; Mashobra, Bliss.

N.-W. P.: *D. D. Dist.*—in the Dún: Nalota Khála 2600', Hope; Mussooree 55-6500', in many places, on trees, Duthie, Mackinnons, Hope; *T. Garh.*—Jumna Vy. 6-7000', Duthie, Sahla Vy. 6000', Gamble; *Kumaun*—R. Bl.; Mohargiri 6500', S. and W. 1848; Hawalbágh; Naini Tál, S. and W., Hope, Davidson; near Askot 4-5000', Duthie; Nalena Vy. 47-5000', on rocks, Hope; Sarju Vy., Bansi 5500' Trotter; Goriganga Vy. 8500', Kála Muni Ridge 8500', MacLeod.

DISTRIB.—*Asia*: N. E. Ind. (Him.) Nepál; Wallich 1821; Sikkim and Bhotán; Assam—Khasia Dist. 3-5000', "very common," Clarke; N. Manipur 5500', Clarke.

See my remarks under *P. amœnum*, Wall., No. 14, above. Occasionally, when growing in an exposed dry situation I suppose, this fern is very small and wiry: Duthie's example from the Jumna Valley has fronds only  $4'' \times 1\frac{1}{4}''$  l. including stipes. MacLeod's, from the Kála Muni Ridge, Kumaun, is from 6 to 11 in. including stipes. I watched this fern at Mussooree for a number of years, and I believed it was spreading there. It is a striking object, hanging from the large oak trees in the forest, on the north side of the ridge, up to 6500' alt., and I could easily distinguish it from *P. microrrhizoma*, Clarke (which is much more common) at some distance. The elevation—"up to 11,000'"—given in the *Synopsis*, seems much too high, and Clarke's higher limit, 6000', is too low; but Beddome has cut that down to 3000', on what authority I know not. Blanford says—"Not very common at Simla. Found on trees and rocks in shady ravines below 6000'."

16. *P. microrrhizoma*, C. B. Clarke, in Trans. Linn. Soc., 2d. Ser. Bot., Vol. I, 1880, p. 551 (C. R.); Syn. Fil., 2d. Ed., 511. *Goniophlebium microrrhizoma*, Clarke, Bedd. H. B. 322.

KASHMIR.—*vide* Clarke; Trotter in Lists.

PUNJAB: *Chamba*—McDonell in List; J. Marten 5-7000', 1897; *Mandi State* 5000', Trotter; *Kangra Vy. Dist.* Dalhousie, Clarke; *Kullu* 7-9000', Trotter; *Simla Reg.*—Simla, and eastward along ridge to Matiana 6-9000': "very common on rocks and trees from 5500' to 8500'" (Blanford in List).



N.-W. P. : *D. D. Dist.*—Mussooree and Landour 6-7500', everywhere, on rocks and trees; *B. Garh.*, Mrs. Fisher; *Kumaun*—Jagesar 6060', S. and W.; Naini Tál; Eali Vy. 9-10,000', Duthie; Goriganga Valley 7000', MacLeod.

DISTRIB.—*Asia* : N. Ind. (Him.) Sikkim and Bhotan; Assam—Jakpho Mt. 9000', *Clarke* : China—Yunnan, *Delavay*, *Henry*.

Besides the difference in the scales of rhizome between this species and *P. lachnopus*, distinguishing characters of *microrrhizoma* not mentioned by Mr. Clarke are—the brown stipes, and darker brown rhachis; the broader, shorter, and rather stouter frond; pinnæ much fewer—generally only 15-25 pairs—and broader; and sori often oblong or oval. At Mussooree this fern grows to a higher level than *P. lachnopus*. The rhizome does not strike me as being very small.

17. *P. argutum*, Wall.; Syn. Fil. 511; C. R. 551. *Geniophlebium argutum*, Wall. (under *Polypodium*), Bedd. H. B. 323.

N.-W. P. : *D. D. Dist.*—Mussooree 6500', Hope 1885; *T. Garh.*—Nág Tiba Mt. 8000' Mackinnons 8000'; *B. Garh.* 6-7000', Duthie 1885, Mrs. Fisher; *Kumaun*, R. Bl.; Binsar, on trees, 7000', S. and W. 1848, and Major Madden; Naini Tál 5-8000', on trees, Hope 1861, Davidson 1875; between Gini and Munshiari 7-8000', above Gini 6-7000', and Gori Vy. 7-8000', Duthie 1884; above Lonarkhet 7500', Trotter 1891; Ránti and Kála Muni Ridge 7-10,000', MacLeod 1893.

DISTRIB.—*Asia* : N. Ind. (Him.) Nepál, *Wallich* 1829; Sikkim and Bhotán, 4-9000', very common; Assam—Khasia.

Mr. Clarke gives—"Himalaya, from Kashmir to Bhotán, very common" as habitats for this species, but I cannot find any specimens from the westward of Tehri Garhwal in the N.-W. Provinces, nor did Mr. Trotter; and Mr. Blanford is silent as to the Simla Region. The Jaunsar Tract of the Dehra Dún District also seems a blank.

My plant from Mussooree is from the only known station in, or within, two days' journey of that place: it must be 10 or 15 miles from Nág Tiba Mt. in a straight line across the deep valley of the Aglar River. I found the fern in Mussooree on one branch of one *Rhododendron (arboreum)* tree only, and left most of the rhizome and fronds on it, and it was still there in 1895, but did not appear to have spread to other trees. *P. argutum* was pretty common in Naini Tál in 1861, on the Sher-ka-danda side of the Lake, high up.

#### Subgenus NIPHOBOLUS, *Auct.*

19. *P. adnascens*, Sw.; Syn. Fil. 349; C. R. 552. *Niphobolus adnascens*, Sw. (under *Polypodium*), Bedd. H. B. 324.

N.-W. P. : *B. Garh.* 3-4000', P. W. Mackinnon 1881; *Kumaun*—Bamganga R. 2500. S. and W.; 4-5000' and 3-4000', Duthie 1884; Sarju Vy. 3500', Trotter 1891; "Goriganga Valley and elsewhere," 5-8000', MacLeod 1893.

DISTRIB.—*Asia* : "Throughout N. India in moist climates," *Clarke*. Himalaya—up to 5000' and even 8000'; "extending over the plains to Calcutta and the sea-face of the Sunderbun"; Assam—Kachar, *Mishmi Griffith*, Manipur, *Watt*. S. Ind. Burma—

Mergui, *Griffith*, Andaman Islands. Ceylon. Malaya. Tonkin. China.—Yunnan. Chusan. Fiji. New Hebrides,—Aneiteum N. Australia—Cape York. *Afr.*: Cainerun Mts. Eritrea, G. Schweinfurth, 1896 ? Mascaren Isles.

New to N.-W. India ; and there not found westward of the Ganges.

20. *P. stigmatosum*, Sw. ; Syn. Fil. 350 ; C. R. 553. *Nipholobolus stigmatosus* Sw., Bedd. H. B. 328.

N.-W. P. : *T. Garhwal*—4000', Mackinnons 1878 ; below Laluri 3-4000', Duthie 1881 ; *Kumaun*—Sarju Vy.—Gangoli Hât 3000', Major Madden ; Kâli Vy. 2-3000', Duthie 1884 ; Gola Valley 2300', Hope 1890 ; Sarju Vy.—Bageswar, T. T., 3000' S. and W., Trotter 1891 ; Sarju and Goriganga Valleys 3-5000', MacLeod 1893.

DISTRIB.—*Asia* : N. Ind. (Him.) Sikkim and Bhotân 1-4-5000', Assam—Khasia 2-3000' very common ; W. Manipur 3500', *Clarke* ; Bengal—Chutia Nagpur, Parasnâth Mt. 2500', *Clarke*. S. Ind.—Golconda Mts. Burma—Tenasserim. Sumatra, *Hancock*. China—Yunnan, *Henry*, *Hancock*.

21. *P. fissum*, Baker ; Syn. Fil. 351 ; C. R. 554. *Nipholobolus fissus*, Bl., Bedd. H. B. 330.

KASHMIR : *vide* Clarke in 'Review', and Trotter in Lists.

PUNJAB : *Chamba*—Ravi Vy. 6000', McDonell ; 5500', J. Marten 1897 ; *Kullu*—Upper Biâs Vy. 5-6000', Trotter ; *Simla Reg.*, Blanford : "rare, and found only at levels below 5500'" ; below Simla 5500', Hope ; Simla—"The Glen" and road to it, Jaru-ka—Nâl, Bliss 1890-92.

N.-W. P. : *D. D. Dist.*—Jaunsar, Duthie 1879, Lokâr, Gamble ; "Jaunsar," C. G. Rogers ; Molta Forest, 5000', Gamble ; *T. Garh*, 5-8000', Gamble, Mackinnons ; *B. Garh*, Mrs. Fisher ; *Kumaun*—near Bagesar 3000', Vy. of Sarju 3500', native collector, in Herb. Hort. Saharanpur ; Gola Vy. 23-4000', very abundant, on rocks and trees, Hope ; Naini Tâl and elsewhere 5-6500', Hope, Duthie ; near Almora 5000' MacLeod.

DISTRIB.—*Asia* : N. Ind. (Him.) eastward to Bhotân, very common ; Assam—Khasia 1000'-5000', very common ; Manipur, *Watt*. S. Ind.—W. Mts. 3-8000'. Burma—The Shân Hills, *Collett* ; Ceylon—C. Prov. Malay Penins. Java. Philippines. China. *Afr.* : E. Trop. Zambesi Highlands. Madagascar.

22. *P. flocculosum*, Don ; Syn. Fil. 351 ; C. R. 554. *Nipholobolus flocculosus*, Don, Bedd. H. B. 331.

PUNJAB : *Kangra Vy. Dist.*—Dharmasala 6000', Trotter 1887 ; Simla—Edgew., and Madden, *vide* Sir J. W. Hook.

N.-W. P. : *D. D. Dist.*—from 2000' to 5000' : common from south of Dehra, in Dehra, northward to Rajpur, and to above Jhari Pâni on road to Mussooree, on trees ; *Kumaun*—3000'-6000', very common.

DISTRIB.—*Asia* : N. Ind. (Him.) Sikkim and Bhotân, rare ; Assam—Khasia, up to 4000', and Sylhet Plain.

The description of the shape of the frond in the '*Synopsis*'—"narrowed very gradually to both ends"—is wrong, and subsequent writers have not put it right. Clarke says—"Suddenly or gradually narrowed at base," and Beddome—"lanceolate, finely acuminate, sub-sinuate, moderately attenuated and decurrent, or broad and unequally hastate at the base." The frond is never

gradually narrowed to both ends—so far as I can see. It is gradually narrowed to the apex, but always more or less suddenly to the base. Only occasionally it seems to be narrowed to the base equally on both sides; but that sometimes is because one side has been folded up in pressing, or when the shoulders are narrower than usual. I should describe the frond as—lanceolate acuminate, one half ending at the base before the other, both halves decurrent on the stipes. It is as if two longitudinal halves of lance heads, of unequal length, were joined together so that the points coincided. The shorter side is sometimes more suddenly narrowed than the other. In the same plant some of the fronds will have the shorter half of the lance head on one side, and others on the other—according as, I think, they have sprung from one or other side of the rhizome. Specimens with fronds narrowed at both ends are probably *P. fissum*, which have got mixed. The latter-mentioned species has sometimes rather broad fronds, and it too sometimes narrows below rather unequally; but it has hardly any stipes, whereas *P. flocculosum* has a stipe of one-third or more the length of the frond.

*P. flocculosum* is very common in Dehra, and along the road and canal avenues up to Rajpur at the foot of the Himalaya, alt. 2100-3000', chiefly on Mango trees, which have rough bark; but since I first observed it in 1879-80 it seems to have spread also to Toon trees (*Cedrela toona*), the bark of which is much smoother. Above Rajpur, up to about 5000', it grows in the forest on various kinds of trees, *Bauhinia* and others. It is also very abundant in the forest in the Gola Valley, below Naini Tal, up to 5000' or higher, on rocks as well as on trees. This plant does not shed its fronds annually: they are persistent for a time, shrivelling up at the close of the rains, or during a prolonged break in them, and uncurling and appearing quite fresh after a good fall of rain in the dry season, or at the setting in of the next season's rains—quite hygroscopic in fact. This may be a character of all the species of *Niphobolus*, as it is of certain species of some other genera and subgenera—see *Asplenium exiguum* above, and *Polypodium* (*Phym.*) *lineare* below. Plants of *P. flocculosum* may be taken from a tree in the cold, or dry hot, season, soaked in water till they uncurl, and be then made good specimens of, though of course without young fronds. Mr. Trotter took some plants from Dehra to Rawalpindi, and so treated them, and laid them into his herbarium. The rhizome is slow growing and never found of any considerable length, and it throws up only a few fronds each year, in a tuft. The fronds probably live on until the rhizome dies off at the back end.

Subgenus DRYNARIA, Bory.

23. *P. propinquum*, Wall., Syn. Fil. 367: C. R. 556. *Drynaria propinqua*, Wall., Bedd. H. B. 539.



N. W. P.: *T. Garh.*—in Herb. Hort. Saharanpur: marked "Kidarkanta, 5", on ticket: no collector's name. *B. Garh.*—6000', Mackinnons 1881; Kinoli Vy., Duthie 1885; Mrs. Fisher; *Kumaun*—Ramari 4500', Binsar 7000', S. & W.; Alaknanda Valley, near Joshináth, Edgew.; Mymunda, Davidson 1875; Gori Vy. 5-6000', Duthie 1884; Nalena Vy. 47-5000', Hope 1880; near Pitoragarh 6500', Trotter 1891; Sarjunga Vy. and elsewhere 4-7000', MacLeod 1893.

DISTRIB.—*Asia*: N. Ind. (Him.) Nepál, *Wallich*; Sikkim and Bhotán, "very common," *Clarke*; Assam—Khasia Dist. 2-5000', very common, Kohima 6000', *Clarke*. Burma. Malay Penins. Java. China—Szechwán, on Mt. Omei, *Faber*; Yunnan, *Delavay*, *Hancecock*, *Henry*. *Afr.*: W. Islands.

24. *P. rivale*, Mett. MSS.; Syn. Fil. 367; C. R. 556. *Drynaria mollis*, Bedd. H. B. 341.

PUNJAB: *Chamba*, MacDonell; *Kullu* 8-900', Trotter; *Simla Reg.*—Simla and eastward to Hattu Mt. 7-9500', on oak trees: locally abundant.

N.-W. P.: *D. D. Dist.*—Janssar, Deoban 9000', Herschel and Duthie's collr. 1875; Jandour 7100', Hope; Garhwal 8-9000'; Lev., *T. Garh.*—Nag Tibá Mt. 9000' Mackinnons; Jumna and Ganges Valleys 8-10,000' and 5-6000', Duthie; *B. Garh.*, Mrs. Fisher; *Kumaun*—Binsar 7000', S. & W.; Naini Tál and near it, Hope, Trotter; Gorikanga Vy. 8700', MacLeod 1893: "Grows in enormous tufts, built up of old stems."

DISTRIB.—*Asia*: Thibet—Soulié, *Hobson*. N. Ind. (Him.) Chumbi Vy., in Thibet, on south slope of Himalaya, King's collector, 1882. China—N. Shen-Si Prov. *Revd. J. Giraldi* (*P. Baronii*, n. sp., *Christ*).

The '*Synopsis*' gives N.-E. Himalaya as the habitat; but this seems a misprint for N.-W. Him., as the Chumbi Station—between Sikkim and Bhotán—was not then known. Also, in the "*Synopsis*" it is said that the venation is like that of *Goniophlebium*; but Mr. Clarke says it is that of other *Drynarias*. Colonel Beddome gives an exact description of the fern.

Subgenus PHYMATODES, *Presl*.

25. *P. lineare*, Thunb.; Syn. Fil. 354; C. R. 558. *Plecoptis linearis*, Thunb.; Bedd. H. B. 346.

KASHMIR:—*vide* Clarke in 'Review.'

PUNJAB: Hazára Dist.—Kagán Vy. 14,400', Inayat (collector for Herb. Sahar.) 1896; *Chamba*, MacDonell; Mandi State and Kullu, Trotter in List; *Simla Reg.*—5-8000', common.

N.-W. P.: *D. D. Dist.*—In the Dún 2-3000', common; Mussooree 55-6500', in many places; *T. Garh.*—Phedi 4-5000' Duthie; *B. Garh.* Mrs. Fisher; *Kumaun*—2-9000', common.

DISTRIB.—*Asia*: N. Ind. (Him.) Nepal, *Winterbottom*; Sikkim and Bhotán; Assam—Khasia Dist. 500'-6000', "very common," W. Manipur 3000', *Clarke*. S. Ind.—throughout, *Beddome*. Ceylon. Malayan Penins., and Isles. China. Japan. *Afr.*: S. & Centr., with the Islands.

Blanford says:—"This is a fern of comparatively the lower levels. . . . The fronds are thick and coriaceous, and in dry weather roll up from the margins, and so remain for weeks and months, unrolling again, like

*Nipholobolus*, on the return of wet weather." I confirm this. The fronds also sometimes coil up at the apex.

26. *P. simplex*, Sw., Syn. Fil. 27. *P. lineare*, Thb.  $\beta$ , *P. simplex*, Sw., Hk. and Bk. Syn. Fil. 354.

*P. simplex*, Sw., Clarke, Journ. Linn. Soc., XXV. 99. *Pleopeltis simplex*, Sw., Bedd. H. B. 347. *Polypodium (Phymatodes) simplex*, Sw., Blanford, in Journ. Asiatic Soc., Bengal, Vol. LVII., Pt. II., No. 4, 1888, Pl. xx.

PUNJAB : *Chamba*—McDonell, in List. Pangi—Satrundi, Harsukh (collr. from Sahar. Herb.) 1899; *Kangra Vy. Dist.*—Edgew. in Herb. Sahar.; Dharmasála, Trotter; Kullu 6-7000', Trotter; *Mandi State* 6500', Trotter; *Simla Region*—Simla 6-8000', common.

N.-W. P. : *D. D. Dist.*—Jaunsar—Chakráta 7000'; in the Dún—Kalanga Hill 33000', Gamble; Mussooree and Landour, very common 6-7500'; *T. Garh.*—Jumna Vy. 10-11,000', Ganges Vy. 10-12,000' Duthie; *B. Garh.* 8000', Duthie, Mrs. Fisher; *Kumaun* 6500' to 9000', S. & W., Hope, Duthie, Davidson, Trotter, MacLeod.

DISTRIB.—*Asia* : N. Ind. (Him.) Sikkim and Bhotán. China ?

This is a very common fern in the Himalaya, on trees, and it never ought to have been mixed up with *P. lineare*, for, besides other differences, and entire dissimilarity in appearance when growing, the fronds are herbaceous in texture, and wither and fall off directly the rains cease, or before that when a touch of cold, dry wind comes from the north. The fronds of *P. lineare* are persistent for another year at least. Blanford noted this, and said—"Their texture is thin, the venation distinct." The sori when young are completely covered and protected by peltate scales, up to 20 in number to a sorus, which fit together so closely that to the naked eye they sometimes look like one large involucre with a continuous margin outside the sorus. These scales disappear as the sporangia ripen and burst. The sori are occasionally oval or confluent.

This species is still mixed up with *P. lineare* in the Kew Herbarium. Specimens from the eastward of British India seem to vary a good deal, and there may be among them a new species.

27. *P. clathratum*, C. B. Clarke in Review 559, t. 72, fig. 1; Baker in Ann. Bot., Vol. V., No. XVIII. *Pleopeltis clathrata*, Clarke, Bedd. H. B. 348. *Polypodium (Phymatodes) clathratum*, C. B. Clarke, Blanford, in Journ. Asiatic Soc., Bengal, Vol. LVII., Pt. II., No. 4, 1888, Pl. xxi.

AFGHAN. : Kurram Vy.—10-11,000' Aitch. 1879-80; Peiwar Kotal 7000. Collett 1879.

KASHMIR : *Pir Punjál* 11-12,000', C. B. Clarke; *Gilgit Dist.*—Nittar Vy. 10-11,000', Duthie. *Kajnaag Range and Kamri Vy.* 9-13,000' Duthie 1852; Ridge between Kishenganga Vys., 9-12,000', MacLeod 1891; *Sind Vy.*—Sonamarg 8000', Gammie 1891.

PUNJAB : Hazára Dist.—Kagán Valley, Inayat (collr. Herb. Sahar.) 1897; *Chamba*—Ravi Vy. 7000', MacDonell, Pangi 12,500', J. Marten; *Mandi State* 7-9000'

Trotter; *Kullu* 8-9000', Trotter; *Simla Reg.*—Simla 7000', Hope 1871; Simla—"abundant on trees on north side of Jako Mt. 7000' and a little above that level, and ranges (eastward) up to at least 10,000' on Kamalhari and Hattu," Blanford (in List); Hope, Trotter, Bliss.

N.-W. P. : *D. D. Dist.*—Jaunsar, Mrs. Stansfield; *T. Garhwal* 8-12,000', Duthie; *B. Garh.* 12-13,000' Duthie, Mrs. Fisher; *Kumaun* 9-14,000' Duthie; Lessar Pass 14,000', MacLeod 1893.

NEPAL W. : Kāli Vy., near Kangua 11,000', Nampa Gādh 12-13,000', Duthie.

DISTRIB.—*Asia* : N. Ind. (Him.), N. China, *Hancock*.

Mr. Clarke's description seems to have been written from material gathered in a limited tract, and his drawing is by no means an adequate representation of the plant, which seems to have various forms. The figure shows fronds not more than 6 in. l., including the stipes; and Mr. Clarke says the fronds are small. Blanford's figure is better, as it is of a larger plant, and shows the venation more correctly; but it does not give the "sessile irregularly peltate and lacerate clathrate scales" which are mixed with the sporangia and are the characteristic feature of the plant. He gives a drawing of a scale from the rhizome, and says the fern is readily distinguished from *P. simplex* by its narrow linear fronds, the character of the venation, and the clathrate scales of the rhizome and sori, as if these were identical. Clarke's enlargement of a scale from the sorus is quite different from Blanford's from the rhizome, and is correct: both are clathrate, though their shapes differ. But, as Blanford says, the scales of the sori are not persistent, and it is not easy in dried specimens to find a specimen of them. On some fronds I find similar scales on the under surface quite unconnected with sori.

*P. clathratum*, if all the specimens so named be that species, varies very much in dimensions and shape of frond. Duthie's high-level examples, from Garhwal, Kumaun, and West Nepal, are generally smaller than even Clarke's figure shows, and are rather coriaceous with venation obscure, but they have the characteristic scales in the sori. Duthie's No. 5178 from the Kuari Pass, British Garhwal, 13,000', has a comparatively broad frond and short stipes, like that of *P. simplex*: stipes  $1\frac{1}{4}$ — $1\frac{1}{2}$  in., frond  $4\frac{1}{2}$ — $8\frac{1}{2}$  in. l., narrowed gradually to both ends, but it has the characteristic sorus scales in abundance. Some of my specimens from the Simla Region, gathered late in the season when withering, and with no scales in the sori, have stipes 2 in. l., and fronds 10—12 in. l. by  $\frac{3}{8}$ — $\frac{5}{8}$  in. br. Some of the sori in these are linear— $\frac{3}{8}$  in. l. A frond from the Mandi State, collected by Trotter, has stipes under 2 in. l., with frond 12 in. by  $\frac{5}{8}$  in. A plant of Blanford's, from Kamalhari Mt., 9500', is only 4 in. high, rather coriaceous, with venation obscure, scales wanting, sori oval or oblong. I collected plants of this form at Simla in 1871, and was then certain they were not *P. lineare*. Fronds from Chamba are 13 in. l. by  $\frac{3}{8}$  to barely  $\frac{5}{8}$  in. broad, very



membranous, stipes very short. I have never seen stipes as long as the fronds such as Clarke speaks of ; but some of Duthie's from Kashmir are  $\frac{3}{4}$ ths of the total length, and some of these have fronds  $\frac{3}{4}$  in. br., and look like narrow *P. simplex*. If the nature of the scales is the main specific character, all these various forms are one species.

Blanford made a particular study of this fern at Simla, where it is very abundant on Jako mountain, and he was at first inclined to make two varieties besides the type ; but in his finally printed list he gave that up. He says *P. clathratum* is quite distinct from both *P. lineare* and *P. simplex*, though it often grows with the last-mentioned, which it much resembles in texture and mode of growth. "The sori," he says, "are small, frequently oblong, of a bright orange colour, and sometimes confluent. . . . The stipes are generally shorter, and the fronds longer and more linear than in the specimen figured by Clarke." The sori are sometimes very large, e.g., in a specimen of MacLeod's from Kashmir they are one-eighth of an inch in the largest diameter, and more than one-quarter the width of the frond : these are full of scales. This species is not got in Mussooree, where both *P. lineare* and *P. simplex* are very common.

*P. alberti*, Regel—Descr. Pl. nov., No. XVIII, 122, from Turkestan, is exactly the same as a small form, called *P. clathratum*, from the Himalaya at high altitudes, which might perhaps be separated and put under *P. alberti*.

28. ***P. membranaceum***, Don,  $\beta$ ., *P. grandifolium*, Wall. ; Syn. Fil. 360 ; *P. membranaceum*, Don, C. R. 560. *Pleopeltis membranaceum*, Don, Bedd. H. B. 355.

KASHMIR : Tawi Vy. 4-5000', Trotter.

PUNJAB : Chamba State—Chenab Vy. 5000', McDonell : "not common" ; Kangra Vy. Dist.—*vide* Trotter ; Simla Reg.—Simla, common.

N.-W. P. : D. D. Dist.—in the Dún : Nalota Khála and elsewhere at the foot of the Himalaya, 2500' and upwards ; Mussooree 5-7000', on moist rocks, and trunks of trees, common ; T. Garh. Aglár Vy. 4-5000', Duthie ; B. Garh.—Mrs. Fisher ; Kumaun—Mohargiri 6500', S. & W. ; Naini Tál 6500', on rocks by the Lake, Hope 1861 : not seen there in 1890 and 1894 ; elsewhere 25-5000', widely distributed.

DISTRIB.—Asia : N. Ind. (Him.) Sikkim and Bhotán ; Assam—Khasia Dist. 2-5000' : very common ; Bengal—Parasnáth Mt. 3000', Clarke. S. Ind.—E. & W. Mts., 2-5000'. Ceylon. Tonkin. W. China—Yunnan, Henry. Philippines.

Usually large ; but I have a fertile frond gathered in Kumaun, only 5 inches high, including the short stipes. All the specimens I possess seem to belong to Wallich's *P. grandifolium*, which is said to have sori smaller, and irregularly scattered.

29. ***P. heterocarpum***, Bl. (non Mett.) ;  $\beta$ ., *P. Zippellii*, Bl., Syn. Fil. 360 ; *P. Zippellii*, C. R. 561. *Pleopeltis Zippellii*, Bl., Bedd. H. B. 357.

PUNJAB : Chamba—Dalhousie, Col. Dyas, *vide* Bedd. in H. B.

DISTRIB.—*Asia* : N. Ind. (Him.) Sikkim and Bhotán, 2-6000', common ; Assam—Khasia, 2-4000', frequent, W. Manipur 1000', *Clarke*. Ceylon. Malay Peninsula. Perak. Sumatra. Java. Borneo. Philippines. China—Yunnan, *Henry*.

I give this as a North-West Indian species solely on the authority of Colonel Beddome. Mr. McDonell, who lived for years in Chamba, close to Dalhousie in charge of the forests, never found it there. I do not think the habitat, "N. India," in the '*Synopsis*,' means including N.-W. India any more than it does when given for *P. vridiodes*, Jamk., the next N.-E. Indian species, or for *P. hemionitideum*, Wall.

30. *P. oxylobum*, Wall. Cat. 294. *P. trifidum*, Don, Syn. Fil. 363 ; *P. hastatum*, Thunb. var. 2 *oxyloba* (sp.) Wall., C. R. 563. *Pleopeltis hastata*, Th., Bedd. H. B. 362 ; *Pleopeltis trifida*, Don, Bedd. Suppt. H. B. 96 ; *Pleopeltis laciniata*, Bl., Bedd. in Journ. Bot., Aug. 1892.

PUNJAB : Chamba—Dalhousie, McDonell : "abundant" ; Kangra Vy. Dist.—Dharmasála 5000', Trotter ; Simla Reg.—Simla 6200', Blanford : "very rare. In fact I know of only one locality for it, near Simla" ; Simla—3 stations, Bliss ; Bisahir—Taklech 5000', Lacey.

N.-W. P. : D. D. Dist.—Sowarna Nála 4500' ? ; Badrāj Mt. and 'The Park', on the Mussooree Ridge, Mackinnons 1878-79 ; 'The Park' 6300', on trees, Hope 1887 and 1895 ; The Castle Hill 6100', A. Hope 1885 ; C. W. Hope 1892 and 1895, in quantity, on a rock, T. Garh., Ganges Vy. 7-8000', Duthie 1881 ; Dura 5000', Gamble 1893 ; B. Garh., Mrs. Fisher ; Kumaun—R. Blink 1827 ; Binsar 7000', S. & W. ; near Naini Tál, Hope 1861, Nalena Vy. 4700', Hope 1890 ; above Lohakhet 75-8000', Trotter 1891 ; Kála Mani Ridge 8500', MacLeod 1893.

DISTRIB.—*Asia* : N. Ind. (Him.) Nepal Wallich ; Sikkim and Bhotán : not common ; Assam—Khasia Dist. 2-6000' : common, Kohima 6000', *Clarke*. S. India—5000'-8600'. Ceylon, *Mrs. Walker*. China—Yunnan, *Henry*. Japan.

A thoroughly good species, in my opinion.

31. *P. malacodon*, Hook. ; Syn. Fil. 363 : C. R. 564. *Pleopeltis malacodon*, Hook., Bedd. H. B. 363.

PUNJAB : Kullu—Jalori Pass 10000', Rohtang Pass 10-13,000', Trotter 1887 ; Simla Reg., Bates ; Kamalhari and Hattu Mts. 9-10,500', on rocks, Gamble, Collett, Hope, Trotter, Bliss.

N.-W. P. : T. Garh.—not infrequent at 9-13,000' alt., Mackinnons, Duthie, Herschel, Gamble ; B. Garh.—near Ramri 9-10,000', and above it 12,000', Duthie ; Kumaun Sarju R. 4500', and Kala Mundi Pass 8000', S. & W. ; Kali Vy. 12-13,000', Duthie ; Pindar Gorge 10,000', Trotter.

DISTRIB.—*Asia* : N. Ind. (Him.) 9-13,000', Nepal to Bhotán.

Mr. Clarke says :—"A very common fern, known at once by its strongly serrate margin. It is remarkable that I find no example in the Kew Herbarium (other than my own) except some pieces mixed on a sheet of T. Thomson's, said to have been collected top of Hattu, alt. 10500', in the North-West Himalaya." But Mr. Clarke restricted the range of habitat to 'Nepal to Bhotan'. Hattu Mt. is now a well-known habitat for *P. malacodon* : it was got there in 1876 by

Gamble, and in 1878 by Collett; and, as will be seen above, the fern grows in many other places west of Nepál.

The scales of the rhizome have not been correctly described by Baker or Clarke: they are not "brown or nearly black," or "brown black." They are bicoloured, *i.e.*, pale-brown with a broad dark-brown streak down the centre. Clarke says—"Frond often sub-cordate at base." Among the numerous specimens in Gamble's and my collections I cannot find a frond that is not cordate or sub-cordate below. Many examples have sori oval or oblong, the major axis directed towards the margin. Some of Duthie's specimens from British Garhwal, 12,000', have sori biserial between the veins, often confluent. These grew on trees; but elsewhere, so far as I know, the fern is always on rocks. I can see no resemblance to, or affinity with, *P. oxylobum*.

32. *P. cyrtolobum*, J. Sm., C. R. 563. *Pleopeltis Stewartii*, Bedd., Syn. Fil. 2d. ed. 573. *Pleopeltis malacodon*, Hook., var. *β. majus*, Bedd. H. B. 363, and Suppl. 96.

PUNJAB: *Chamba*—MacDonell; *vide* Beddome in Suppl. H. B.

N.-W. P.: *D. D. Dist.*—Mussooree, "The Park" 63-6500', Mackinnons 1880, Hope 1887 and 1890; *Kumaun*—Binsar 7500', S. & W.; Gori Ty., 7-8000', Trotter 1891; *Mangalia Gor* 10,000', MacLeod 1893.

DISTRIB.—*Asia*: N. Ind. (Him.) Nepál to Bhotán 9-12,000': very common, Clarke; Assam—Jakpho Mt. 8500' Clarke; Khasia Dist. 5000', Clarke.

This species is not in McDonell's List of Chamba Ferns, and I have seen no specimen from the westward of Mussooree. Trotter in his printed list said he had a Chamba specimen from McDonell; but the species does not appear in his later MS. list given to me; and I have four fronds of *P. oxylobum* marked by him *P. cyrtolobum*.

I am not much surprised that writers with a tendency to unite species, and who have not seen this growing in its natural habitats, thinking it a form of *P. malacodon*, at least if they can get over the marked differences of cutting and scales of rhizome. But, having seen *P. malacodon* growing only on rocks in the Simla Region, at high elevations, and *P. cyrtolobum* growing only on trees in Mussooree, at a much lower elevation, and having observed their very different habit and appearance, I cannot hesitate to agree with Clarke in separating them. The scales of the rhizome are bicoloured like those of *P. malacodon*, but they are much narrower and darker coloured, and they end in long thick hairs. The frond is less cordate at the base, and sometimes quite decurrent on the stipes; and the texture is much thinner than that of *P. malacodon*. The fronds vary from occasionally simple to three-lobed, and to three pairs of lobes, besides the long terminal lobe. Major MacLeod's two fronds in my possession, from Kumaun, are—one, trilobate, and the other, with stipes over 4 in., has a frond 10 in. l. with 4 pairs of lobes—the longest nearly 6 in. l. A frond from Mussooree is nearly 12 in. l., with terminal lobe all but 8 inches.



33. **P. Stewartii**, C. B. Clarke, in Trans. Linn. Soc., 2d. Ser., Bot., Vol. I., 563—the 'Review.' *Pleopeltis malacodon*, Hook., *P. Stewartii*, Clarke : a variety less serrated, Bedd. H. B. 363.

PUNJAB : *Chamba*—Ravi Vy., below Sach Pass, 9500', McDonell 1882 ; 9900', J. Marten 1898 ; *Simla Reg.*—Simla, near the Tunnel 7400', Bliss 1886-90-92.

N.-W. P. : *D. D. Dist.*—Seals' Hill E. of Landour, 7000', Miss Parrott (by whom indicated to Hope) 1887 ; Hope 1895 : *Kumaun*—Binsar 7000', S. & W. ; top of Liria Kanta Mt. about 8000', Hope 1861 ; Summit of Dhankuri Pass 10,500' and Phurki, Trotter 1891.

DISTRIB.—*Asia* : N. Ind. (Him.) Sikkim 12-13,000', Lachen, *Sir L. D. Hooker*. *China*—*Henry*.

Beddome meant, I think, *P. cyrtolobum* as having been collected in Garhwál by (Dr.) Stewart, as this statement is made with reference to the fern depicted in his Plate 204 in F.B.I., which seems to be *P. cyrtolobum*. Clarke wrongly referred to that Plate under his *P. Stewartii*. This species hardly grows so large as its congeners do, and it is a stiffer plant—subcoriaceous in texture : the fronds do not hang down, but stand up, or spread out, if growing on the face of a rock. The paler scales on the rhizome distinguish it. It seems a rare plant. As to the Simla Region, Blanford says :—"Very rare, and has found at been only one place near Simla, on rocks at an elevation of about 7400 feet."

34. **P. ebenipes**, Hook. ; Syn. Fil. 365 ; C. R. 564 ; *Pleopeltis ebenipes*, Hook., Bedd. H. B. 363.

PUNJAB : *Chamba*—McDonell, *vide* Trotter ; J. Marten 1896 ; Kullu 9-10,000', Trotter ; *Simla Reg.*, on ridge east of Simla 8-10,000'. T. T., Edgew., Bates, Blanford, Hope, Trotter, Bliss.

N.-W. P. : *D. D. Dist.*—Jaunsar—Hariana 8500', Gamble 1895 ; *T. Garh.* Nag Tiba Mt. 9000', Mackinnons ; under Bandarpunch 10-11,000', and Bok Mt. 9-10,000', Duthie ; *B. Garh.* 6-7000', on trees, Duthie, Mrs. Fisher ; *Kumaun*—Kalamundi 8700', S. & W., Dhankuri Pass 8-8500', Trotter, Kala Muni and Mangalia Gor Ridges 8-10,000', MacLeod.

DISTRIB.—*Asia* : Tibet—Yatung, *Hobson* ; N. Ind. (Him.), Sikkim and Bhotan.

Besides the broad, black, opaque, polished scales on the rhizome a marked distinction between *P. ebenipes* and its congeners is the much greater number of lobes, and consequently the longer frond ; the number of lobes seems to be 7-13 pairs. There are no fronds of *ebenipes* decurrent at base in Gamble's and my collections. Otherwise, Beddome's remarks as to the distinctions between members of this group seem good.

#### Subgenus PLEOPELTIS, H. & B.

35. **P. juglandifolium**, Don ; Syn. Fil. 368 ; C. R. 566. PLEOPELTIS, Bedd. H. B. 308. *Polypodium capitellatum*, Wall. Cat. 306.

PUNJAB : *Simla Reg.*—Simla, Lady Dalhousie 1831 ; Bisábir, Taklech 5000', Lace.

N.-W. P. : *D. D. Dist.*—Landour 7000', Colonel Wilmer (comm. to Mackinnons 1878); Seal's Hill, E. of Landour, Hope 1887 and 1895 ; *T. Garh.*—between Orr and Ram-sarai, Duthie's collr. 1879 ; between Betwari and Dangulla 5-6000' ; 7-8000', Duthie 1881 ; Kidarkanta ; Jodargadh Waterfall and rocks near Suranu-ka-Ser 6000', Gamble 1898 ; *B. Garh.* 7-8000', Duthie 1885, and Mrs. Fisher ; *Kumaun*—Sarjn R. and Pass to Mohargiri, S. & W. 1848 ; Naini Tál 7000', on trees, Hope 1861 ; Goriganga Vy. 6-8000', MacLeod 1893.

DISTRIB.—*Asia* : N. Ind. (Him.) Nepál, *Wallich* ; Sikkim and Bhotán ; Assam—Khasia 2000'-5000', very common, *Clarke* ; Kohima—Jakhpo Mt. 7500', *Clarke* ; Manipur 7500'. Burma—Moulmein, China—Yunnan, *Henry*, Yunnan—Mengtze, *Hancock*, "very rare."

Perhaps the omission of localities for the type, from Beddome's Handbook, is due to a misprint. None of the specimens I have from N. and W. India are petiolate, and otherwise they seem quite normal. At Naini Tál I used to see this fern growing on trees. At Mussooree (Landour) it grows in dense masses on a steep bank, under scrub forest, the fronds hanging down gracefully. In Kumaun MacLeod found it growing in large overhanging masses on precipitous rocks. I have a frond, Trotter's No. 959, 1891, from near Naini Tál, named by him *P. himalayense*, Hk., which I now think is *P. juglandifolium* var. *biseriatis* of Clarke, which was got in Kumaun long ago, *vide* a specimen in the Kew Herbarium. The form *B. P. tenuicauda*, Hk., does not appear to have been got in N.-W. India.

36. **P. Lehmanni**, Mett. ; Syn. Fil. 369 ; C. R. 566. *Pleopeltis*, Bedd. H. B., 370.

N.-W. P. : *B. Garhwál*—near Ramri 12,000', on rocks in forest, Duthie No. 5177, 1885 ; loc. ? P. W. Mackinnon ; Mrs. Fisher.

DISTRIB.—*Asia* : N. Ind. (Him.) Nepál, *Wallich* ; Sikkim 4-8000', common, *Clarke*. Burma. China—Yunnan, *Delavay*, *Henry*.

Duthie's plant from British Garhwal is a remarkable sport. The specimen he gave me is one frond, with three inches of rhizome sending out side-shoots. The scales are typical. The stipes is  $5\frac{1}{2}$  in. l.—the frond 10 in. l.,  $8\frac{1}{4}$  in. br. : pinnæ 5 pairs, sessile, lowest  $4\frac{1}{2}$  in. l., and next 3 pairs not much shorter : all, and the terminal pinna, have the veins irregularly prolonged, so that the lowest pair of pinnæ are in places 3 in. br. : the pinnæ are very opposite and very acuminate. There is a similar specimen in Kew, also from Duthie. No fertile fronds of this were found by Mr. Duthie. I have lately received from Mr. Gamble two fronds, quite typical, collected in British Garhwal by Mrs. Fisher, with pinnæ very opposite and very acuminate. Mr. Mackinnon's specimens want rhizomes ; but I have other grounds for believing this species grows in Garhwal, for fronds of what I could only so name grew up from among a mass of rhizomes of—I forget what other species—which the Mackinnons brought from an inner range of the Himalaya, and had in cultivation at Mussooree, about 1881.

## Genus 28. NOTHOCHLAENA, R. Br.

1. *N. vellea*, R. Br., Prod. 146 : *N. lanuginosa*, Desv., h. Fil. 370.  
*N. vellea*, R. Br. Bedd. H. B. 375.

AFGHAN. : Griffith, in Herb. Hort. Kew ; see also Baker in Ann. Bot. V., No. XVIII.

KASHMIR : *vide* Beddome in Handbook.

PUNJAB : *Chamba*—Ravi Vy., below Pokri, 3500' and under : "also found in other places at 3500' or so," McDonell 1882 ; "Chamba", 3000'. J. Marten 1897 ; Kangra Vy. Dist.—Lahaul, *vide* Bedd. H. B., Pangi and Lahaul, 9-12,000', Dr. Watt, in Herb. Hort. Kew.

DISTRIB.—*Eur.* : Spain, Sardinia, Italy, Sicily, Greece, Crete. *Asia* : Syria ; S. Persia, Dr. Stapf ; E. Persia, Bornmüller. *Australia* : temperate and tropical. *Afr.* : Macaronesian Isles, S. Morocco, J. D. Hooker, Algeria, Nubia.

I think this fern was found in Chamba (or Kashmir) by Mr. Ellis before Mr. McDonell found it. Mr. McDonell did not know it, and sent it to Mr. Levinge, and to me—or Levinge sent it to me. Levinge marked it "*Woodsia* sp." ? I recognised it as *N. lanuginosa* from a coloured drawing in 'Britten's European Ferns.'

Mr. Marten has quite lately found it in the Chamba State.

2. *N. Marantæ*, R. Br. ; Syn. Fil. 371 ; C. R. 567 ; Bedd. H. B. 373.  
 KASHMIR : *vide* Clarke in 'Review.'

PUNJAB : *Chamba*—Ravi Vy., Thála 11,000', McDonell 1885 ; *Kullu*, summit of Jalori Pass 10,500', Trotter ; *Simla Reg.*—ridge E. of Simla 8000' to 10,200', Bates, Blanf., Hope, Trotter, Lacey, Bliss.

N.-W. P. : *D. D. Dist.*—Jaunsar 9000', Rogers ; *T. Garh.*—Nag Tiba Mt. 9-10,000', Mackinnons ; Deota 8000', Gamble 1893 ; Balcha, Rogers ; Jamnotri 10-11,000', Duthie 1884 ; *B. Garh.*—above Ramri 8-9000', Dombitla Gádh 9000', Kuari Pass 11-12,000', Duthie ; *Kumaun*—S. & W., Kali Vy. 9-10,000', Duthie and J. R. Reid, Pindar Gorge 8000', Trotter.

DISTRIB.—*Eur.* : The Continent throughout the Mediterranean Region, extending to the Tyrol and Hungary, and to Ardèche and Portugal : in Spain upon the mountains up to 3000'. *Asia* : Syria and Tauria ; Tibet—Yatung Hobson ; N. Ind. (Him.) Sikkim—Lachen Vy. 9-15,000', Hook. Fil. ; Dr. King's collr. 14,000'. *Afr.* : Macaronesia, Barbary States and Abyssinia.

## Genus 29. GYMNOGRAMME, Devo.

Subgenus LEPTOGRAMME, J. Sm.

1. *G. Totta*, Schlecht. ; Syn. Fil. 376 ; C. R. 567. *Leptogramme Totta*, Schlecht., Bedd. H. B. 377.

KASHMIR : *vide* Clarke in 'Review.'

PUNJAB : *Chamba*—Ravi Vy. 6000', McDonell ; *Kullu*—Outer Seoráj 7000', Trotter, 6-8000', Coventry ; *Simla Reg.*—The Chúr (or Chor) Mt. Herschel ; Simla—Bliss 1886-90-92.

N.-W. P. : *D. D. Dist.*—Jaunsar, Harianta 7000', Kathián 7500', Gamble ; *T. Garh.*—Cháchpur Vy. 6000', Duthie ; P. W. Mackinnon, very long ; *Kumaun*—T. T. ; Jagesar 6000', S. & W. ; Edgew., Hawalbagh, in Herb. Sahar. ; Davidson ; near Devidhura 6000', Trotter.







J. N. Fitch del.

Chitra Sipi C<sup>o</sup> Lith.

## GYMNOGRAMME LEVINIEI Baker

- 1. Rhizome, natural size.
- 2. Lower portion of frond, natural size.
- 3. Portion of a pinna, enlarged 3 diam.

DISTRIB.—*Asia* : N. Ind., Assam *Griffith* ; Khasia 3-5000', common, *Clarke*. S. Ind.—very common on west side, at highest elevations, *Beddome*. Ceylon. Sumatra and Java. Japan. China Korea. *Afr.* : Macaronesia ; Guinea Coast ; Fernando Po, and Kamerun Mts., G. Mann. Abyssinia. Cape Colony. Comoro Islands.

2. *G. Levingii*, Baker, in *Annal. Bot.*, Vol. V., No. XVIII., 216. *G. aurita*, var. *Levingii*, C. R. 568. *Leptogramme aurita*, var. *Levingii*, Clarke, *Bedd. H. B.* 379 ; *Leptogramme Levingii*, *Bedd. Suppt. H. B.* 99.—Plate XXXV.

The following is Mr. Baker's description of the Plant :—

"Rhizome slender, wide-creeping ; paleæ lanceolate, membranaceous. Stipe slender, naked 6—8 in. long, stramineous, with a brown base. *Frond* lanceolate, or oblong-lanceolate, bipinnate, membranous, pubescent, 1—1½ ft. long, 3—4 in. br. at the middle, narrowed to the base. *Pinnæ* lanceolate, sessile, ½—¾ in. broad, cut down to the rachis into continuous erecto-patent, linear-oblong *pinnules*. Veinlets erecto-patent : upper simple, lower forked. *Sori* oblong or globose, placed nearer the margin than the midrib. West Himalayas ; Jhelum Valley, alt. 4000' ; Levinge. I follow Mr. C. W. Hope in treating this as a species."

Mr. Clarke, in giving this fern as a variety of *G. aurita*, Hook., said—"It has the texture and hairiness of *G. Totta*, but the rhizome and venation of *G. aurita* ; while the cutting is deeper than that of *G. Totta*, less auriculate than that of *G. aurita*."

I will not attempt to check the various descriptions of the plant, for it might end in writing another, and there are already enough ; but I figure it, as that has not yet been done.

KASHMIR : Palgam 5090', C. B. Clarke. *Gilgit Dist.*—Dashkin 7500', Dr. Giles ; Jhelum and Chitapāni Vys. 4-7000', Levinge 1875, Gulmarg 75-8000', Sind Vy. 7000', Trotter ; Pir Punjal—Hirpur 7000', Sind Vy., Gund, 6000', Gammie ; Farikand Nāla 6-7000', MacLeod—"on the edge of the stream, not under shade. Does not grow away from water."

PUNJAB : *Hazāra Dist.*—Kagān Vy., Inayat (Sahar, Herb. collr.) 1899 ; *Chamba*—above Alwās, and Sach Vy. 8000', McDonell ; "Chamba," J. Marten 1898, Pāngi 8500', Harsukh (Sarhar, Herb. collr.) 1899 ; Kullu, Trotter in List ; *Simla Dist.*—eastward from Simla a ridge, near Theog 8000', Kamalbhori and Hattu Mts. 85-9400', Hope, Blanford, Bliss, Dr. Watt. Kunāwar, T. T. 1847.

N.-W. P. : *D. D. Dist.*—Jaunsar (or *T. Garh.*) : Collected on march from Mussooree to Chakrata, Mrs. J. Sladen, 1880 ; *T. Garh.*—Nag Tiba Mt., Mackinnons 1879 ; Ganges Vy., below Harsil and Derali 8-9000', Duthie 1881 ; Mandraoli 10—11000', Duthie 1883 ; *Kumaun*—between Gini and Munshiari 7-8000', Dhaulī Vy. 9-10000', Duthie. "*Kumaun*," J. R. Reid 1886.

This fern varies a good deal in shape and cutting of frond. I had a frond 10 in. l., but only 2½ in. br., and another (Hattu Mt., Bliss) which is 18½ in. l. by 7¾ in. br. The greatest width Baker gives is 4 inches, and Beddome—



5½. The rhizome is very slender, and in general not thicker than the stipes. My observation bears out Blanford's and MacLeod's statements as to its love for water or wet ground. Blanford considered this a good species.

Subgenus EUGYMNORAMME.

3. *G. vestita*, Hook. ; Syn. Fil. 379. Subgenus SYNGRAMME, *G. vestita*, Hook. C. R. 568. *Syngramme vestita*, Wall. Cat. 12 (under *Grammitis*), Bedd. H. B. 386.

PUNJAB : *Hazára Dist.*—Black Mt. 6900'. Trotter ; *Chamba*—McDonell, 1885 or previously ; *Mandi State*—near Badwáni 7000', Trotter 1887 ; *Simla Reg.*—Simla 55-7000', frequent ; eastward along ridge, to Kamalhari Mt. 8-9000', Bates, Gamble, Blanford, Hope, Bliss.

N.-W. P. : *D. D. Dist.*—Jaunsar, Lokandi 7000', Konain 7000', Gamble ; Lakhwá, Gammie, "Jaunsar" Mrs. Stansfield 1883 ; Mussooree 6500', Mackinnons 1878-79 ; *T. Garh.* Kidar Kánta Mt. Dr. Royle, and eastward from Landour, 7-7500', Levinge 1872 ; Deota 6000', Gamble ; Ganges and Jumna Vys. 7-9000' Duthie ; *B. Garh.* 6-7000', Duthie ; near Joshi Matt, Mackinnons ; Mrs. Fisher ; *Kumaun*, Wallich 1829 (R. Blink.) in many places—55-8000', S. & W. ; Edgew., Hope, Davidson, Duthie, Trotter, MacLeod, 1861 to 1893.

DISTRIB.—*Asia* : N. India (Him.) Bhotán, China, North and South.

The rhizome is procumbent, slow growing.

The pinnæ in large specimens become bluntly auricled at base on the upper side, or on both sides—sub-sagittate.

4. *G. Andersoni*, Bedd., Ferns of British India, p. , t. 190 ; Syn. Fil. 380 ; C. R. 568 ; *G. Andersoni*, Bedd. H. B. 382.

N.-W. P. : *T. Garh*—Gumbar Pass 12-13,000', Duthie ; *B. Garh.*—near Kuari Pass 11-12,000', Duthie ; *Kumaun*—Pindari 12,000', S. & W. (*Woodsia mollis* on ticket) ; above Namik 11,000', No. S, 695, F. ; Sundadunga Vy. 13,000', Dr. Anderson ; Káli Vy, above Garbyáng 11-12,000', Duthie, Byáns—above Chalek 11-13,000', and Palang Gádh 11,000', Duthie.

NEPAL W. : Nampa Gádh 11-12,000', Duthie.

DISTRIB.—*Asia* : N. Ind. (Him.) Sikkim 14-16,000', Hook. Fil.

"*Woodsia lanosa*, Hook., must be placed here as a synonym" : Baker in Ann. Bot., Vol. V., No. XVIII.

5. *G. javanica*, Bl. ; Syn. Fil. 381 ; C. R. 569. (Subgenus *Syngramme*.) *Syngramme fraxinea*, Don (under *Diplazium*), Bedd. H. B. 386.

KASHMIR : Rattan Pir 75-8000', Trotter ; Dardpura and Andr'bug 6000', common, MacLeod.

PUNJAB : *Hazára Dist.*—Murree, Hope 1882, Trotter 1886 ; *Chamba State*—Kalatop Forest, 6-7000' and upwards, MacDonell ; 5-7000', J. Marten 1897 ; Kangra Vy. Dist.—Dalhousie, C. B. Clarke ; *Simla Reg.*—Simla and eastward along Thibet Road, 5-10,000', common in forest, Edgew., Madden, Hope, Gamble, Blanford, Trotter, Bliss. Giri Vy.—Raiengarh Forest 7000', Gamble.

N.-W. P. : *D. D. Dist.*—Jaunsar, Mandáli 8000', Gamble ; Mussooree 4-5000', several stations, Duthie, Mackinnons, Hope ; *T. Garh.* Srinagar, R. Bl., Bok and Nag Tiba Mts.

9-10,000', Mackinnons, Duthie; Bambu Vy. 6000', Gamble; *B. Garh.* Mrs. Fisher; *Kumaun*—near Kháti 7200'—7800' (both forms) S. & W.; near Naini Tál 45-6000', Hope, Konoor 7000', Davidson; near Bugeswar 3500'; Dhankuri 9000', Trotter; Sarjunga Vy. and elsewhere, 2-6000', MacLeod.

NEPAL, *Wallich*, Centr. Nepál, *Scully*.

DISTRIB.—*Asia*: N. Ind. (*Him.*) E. Nepál *J. D. Hooker*; Sikkim and Bhotán; Assám—Khasia Dist. 1-5000', common. Burma—Tenasserim. Ceylon—5-6000'. Malay Penins. and Isles. Tonkin. Phillipines. China—Shensi, Giraldis, Nau-T. Henry; Yunnan, *Delavay*, *Hancock*; Shing-King Prov., between Mukden and Kirin, *James*. Japan. Polynesia. *Afr.*: E. & W. Tropical; Kamerun Mts., Fernando Po, St. Thomas. Madagascar.

Beddome describes two forms—pinnate and bipinnate; but plants of a form between these two are frequent, *i.e.*, with perhaps only one pair of pinnæ pinnate, and that irregularly so; and there is also a tripinnate fern, as Blanford pointed out. The simpler forms generally grow at low levels, and have large broad, pinnæ and the compound forms always at high altitudes, with small narrow pinnules. The number of pinnæ varies greatly.

Looking to the contrast which the low-level form—with stout stipes and rachis, and large, simple pinnæ, or with only the lowest pair pinnate or partly so—presents with the high level form, bi- or tri-pinnate, with slender stipes and rachis, and with small, narrow pinnules, and also to the differences of margin, I am not surprised that several species have been made out of this plant; but I do not think this is necessary. Blanford says:—"Below 6000' it is bipinnate only as regards the lowest pair of pinnæ and the pinnules are broad and large. Specimens from higher elevations have several pairs of pinnæ again pinnate, and the pinnules are smaller and narrower. It is often 3-pinnate." This is well expressed; but the purely simply pinnate form is not mentioned. The venation varies: in some fronds the veinlets stop short of the margin, and are thickened (clubbed) at the ends, the marginal teeth in that case being quite disconnected from the veins: in most cases the veinlets run into the teeth, and quite to the margin. The anastomosis of veinlets of contiguous groups is, as Beddome says, rare, and I have detected it in only 3 out of 25 fronds. The re-uniting or looping of forked veinlets within the same group is commoner. The veinlets get so close towards the margin that I wonder how, in the simpler broad segment form, they keep separate.

6. *G. leptophylla*, Desv.; Syn. Fil. 383; Bedd. H. B. 382, and Suppt. 100.

N.-W. P.: *D. D. Dist.* Mussooree, Dr. Bacon: in Herb. Hort. Kew; *Kumaun*—Colonel Davidson 1877, in Herb. Hort. Saharanpur: also in Herb. Hort. Kew.

DISTRIB.—*Amer.*: Andes of Mexico and Ecuador; Paraguay. *Eur.*: Jersey, France; Switzerland; Spain and Portugal, Italy and Sicily, Corsica and other Mediterranean Islands, Greece, Turkey. *Asia*: Persia. S. Ind.—W. Gháts, Ootacamund,

Mahableshwar, Satara Fort walls. Ceylon—*Trimen*. Australasia—N. S. Wales, Tasmania and N. Zealand. *Afr.* : Macaronesia, Barbary States and Abyssinia ; Cape Colony and Madagascar.

This species, and two others, are annual, and form the genus *Annogramma* of Link. (Syn. Fil.) Mr. Marquand, a well-known authority on *Algæ*, tells me that *G. leptophylla* is in some years plentiful in Jersey, and sometimes comparatively rare.

Subgenus SELLIGUEA, *Bory*.

7. *G. involuta*, Hook. ; Syn. Fil. 387 ; C. R. 570. *Lexogramme involuta*, Don (under *Grammitis*), Bedd. H. B. 393.

PUNJAB: *Simla Reg.*—Simla 5-6000', Lady Dalhousie, Hope, Blanford, Trotter, Bliss.

N.-W.-P. : *D. D. Dist.*—Mussooree and neighbourhood, in various places 47-6500', on trees, Edgew. Duthie, Mackinnons, Hope ; *T. Garh.*—Phedi 4-5000', Duthie ; *B. Garh.*—below Kinoll 5000', Duthie ; Mrs. Fisher, *Kumaun* 4-8500', on trees and rocks : plentiful in some places, R. Blink., S. & W., Hope, Davidson, Duthie, MacLeod.

DISTRIB.—*Asia* : N. Ind. (Him.) Nepál *Wallich*, Sikkim and Bhotán ; Assam—Khasia Dist. 1-5000', very common, N. Manipur 5500', *Clarke*. S. India—5-8000', Ceylon 5-8000. Malay Penins.—Penang, *Wallich* 1822, China : Yunnan—Mengtze, *Hancock*, *Henry* ; Szechwan *Faber*, Philippines, Polynesia—Solomon Isles.

8. *G. elliptica*, Baker ; Syn. Fil. 389 ; C. R. 570. *Selliguea elliptica*, Thunb., Bedd. H. B. 392.

N.-W. P. : *D. D. Dist.*—Sowarna Nadi, 4500', Mackinnons 1878-79, P. W. Mackinnon and Hope 1881 ; in the Dún—Nalota Khála 2500', Hope 1881, 1889, and 1891 : station shown to A. Campbell, Trotter, and Gamble in 1891.

DISTRIB.—*Asia* : N. Ind. (Him.) Sikkim and Bhotán ; Assam—Khasia Dist., 2500'-5000', very common, Kohima 45-6000', *Clarke*, N. Manipur 4500', *Clarke*. Burma—Tenasserim Prov. Malay Penins. Tonkin, Philippines, Japan, China, Formosa, Australia—Queensland.

I think it is a mistake to put this species, as Baker and Beddome do—  
\* \* Fronds compound ;—there is always a wing, though sometimes nearly interrupted, to the main rhachis in even the longest and most developed fronds ; and Thunberg's name, *elliptica*, and Presl's—*decurrens*, seem to imply this. The fronds are as much a-pinnate as are those of the series of *Polypodium* (Phym.) from *oxylum* to *ebenipes* ; but the main veins or secondary rhachises are stouter than those of the *Polypodiums*. Baker says—" Oldham gathered in Formosa a form with the fronds quite entire," and Clarke says he has an example, in full fruit, quite simple. I have some fronds, gathered in the Dehra Dún from young rhizomes, which are 2—3 in. l., quite simple, but sterile, and I think this simplicity goes to prove that the plant has not pinnate fronds.

A specimen of *G. elliptica* from the Dehra Dún has stipes  $13\frac{1}{2}$  in. l., and frond  $16 \times 11$  in. : it has 7 pairs of lobes, and a terminal. This fern, when dried, tinges paper pink, as does also *Asplenium ensiforme*.



## Genus 30. VITTARIA, Sm.

## Sub-genus TÆNIOPSIS, J. Sm.

1. *V. lineata*, Sw.; Syn. Fil. 396. *V. flexuosa*, Fée, C. R. 574. *V. lineata*, Sw., Bedd. H. B. 407.

PUNJAB : Kangra Vy. Dist., Mr. D. Macdougall, *vide* Trotter in printed List.

N.-W. P. : D. D. Dist.—Vicary, in Herb. Hort. Sahar.; *T. or B. Garhwal* 4-5000', P. W. Mackinnon 1881; *B. Garh.* 7-8000', Duthie 1885; *Kumaun*—Sarju Vy. 4800', S. & W., above Gini 6-7000', near Sosa 9-10,000', in forest, on *Abies dumosa*, Duthie 1884; near Kháti 7500', and above Loharkhet 8-8500', Trotter 1891; above Girgaon 9500', "common trees," MacLeod 1893.

DISTRIB.—*Amer.* : W. Indies and Florida to Peru and Brazil; Brit. Guiana—Roraima. *Asia* : N. Ind. (Him.), Sikkim and Bhotán : "2-12,000', very common," Clarke; Assam—Khásia Dist. 1-6000', very common; Kachar; Manipur, Watt. S. Ind.—on the Western Mts. 2-6000'. S. Andaman Island, Kurz. Ceylon, C. P., common. Malay Penins. and Islands. Tonkin—Balansa. China—Yunnan, Henry, Hancock; Fokien Carter. Japan, Philippines, Borneo, New Guinea, Afr. : Kameruns. Guinea Coast, Ashanti. Centr. Afr.—Ruenzori, Zambesi Land, Natal, Cape Colony. Mascaren Islands, Sechelles.

## Tribe B. ACROSTICHEÆ.

## Genus 60. ACROSTICHUM, L.

## Sub-Genus GYMNOPTERIS, Bernh.

1. *A. (Gym.) virens*, Hook.; Syn. Fil. 420. *A. crispatum*, Wall. Cat. 24, Clarke's Rev., p. 580, Pl. LXXXIV, fig. 2, b, d.—"Barren pinnæ numerous, often 20 or more, 4 by  $\frac{1}{2}$  in., slightly serrate, the midrib often reddish when dry, a series of costal arches, without included veins in any of the areolæ; fertile pinnæ 4 by  $\frac{1}{2}$  to  $\frac{1}{4}$  in."

"Round Bengal from Kumaun to Bhotán and Chittagong in the lower hills, alt. 0-3000', common."

"The only very common species of the group called *A. virens* by Mr. Baker. Very constant in character, and easily recognised by the absence of free veins."

N.-W. P. : *Brit. Garh.*, up to about 3000'; Bhainskil, near Parewa, Kotah Range, coll. Ináyat Khán (native collr. of Sahar. Herb.) 6-1902; *Kumaun* : R. Bl., 2 sheets in Herb. Hort. Kew.

This species is the only *Acrostichum* that has hitherto been found in N.-W. Ind.

## Sub-Ord. III. OSMUNDACEÆ.

## Genus 31. OSMUNDA, L.

1. *O. Claytoniana*, L.; Syn. Fil. 426; C. R. 582; Bedd. H. B. 449.

KASHMIR : Gulmarg 95—10,000', C. B. Clarke 1875, Levinge 1875, Trotter; 8-9000 Duthie; Sarpat Peak over 10,000' : "grows in regular fields, coming up through the melting snow." MacLeod.

PUNJAB : Chamba, 8000' McDonell; Kullu, 6-11,000' Trotter; Simla Reg.—Bisahir, Chini, Vicary 1831, in Herb. Hort. Sahar.; Bári 8000' Lace; Hattu Mt. 10,000', Bates, Blanford, Hope, Bliss; Sirmur Territory 9-10,000'.

N. W. P. : *D. D. Dist.*—Jaunsar, Molta Forest, 4-5000', Gamble; *T. Garh.* Deota 8000' and Bamsu 9000' Gamble; Kidār Kānta Mt. and near it 10-12,000', Col. Bailey, R. E., and Duthie; Nag Tila Mt. 9000'; Mackinnon's; Derāli : Damd. r Vy. 9-11,000', Duthie; *Kumaun*, Wallich 1829, above Namik 8500', Rālam 12,000', S. & W.; ascent from Ramganga R., 8500', S. & W., Rālam Vy. 11-12,000', Duthie; Pindar Gorge 10,000', Trotter; Gori Ganga Vy. 10-11,000', MacLeod.

DISTIB.—*Amer.* : Canada, Newfoundland, and throughout the United States. *Asia* : (Him.) Sikkim : Lachen 9000', *J. D. Hook.*; Bhotān *Griñith*, 6000', *C. B. Clarke*; Assam—Khasi Hills, *Griffith* and *T. Thoms.*

This fern grows much larger than is stated in the '*Synopsis*,' namely, st. 1 ft., frond 1—2 ft. l. I have gathered it in the Simla Region with fronds 4½ ft. long, exclusive of stipes. It unrolls its fertile fronds in May or June, and withers early.

2. *O. regalis*, L.; Syn. Fil. 427; C. R. 583; Bedd. H. B. 450.

PUNJAB : *Chamba State*—Ravi Vy. (Bhandāl Vy.), 5000' and over, and Langera 6000', McDonell 1882, 7000'; J. Marten 1897; *Simla Reg.*—Simla, below 6000', Blanford in List, 1888, "very rare, and now nearly extirpated by assiduous collectors."

N.-W. P. : *D. D. Dist.*—Jaunsar, Molta Forest 4500', Duthie, and Gamble, 1895. *T. Garh.*—Kidarkanta Mt. 12,000', Herschel 1879. *B. Garh.* 5-6000', P. W. Mackinnon 1881; *Kumaun*, T. T., S. & W. ("L. speciosa, Wall."); Hawalbāgh, in Herb. Hort. Sahar. "Asplenium 12; 25-6-49" on ticket; Gori Ganga Vy.—Ranti 8500', MacLeod.

DISTIB.—*Amer.* : Canada and the Saskatchewan to Brazil (Rio Janeiro). *Europe* : British Isles. Sweden and Russia to Spain, Italy and Turkey, Mingrelia, *Szovitz*; *Asia* : Siberia; N. Ind. (Him.) Sikkim and Bhotān; Assam—Khasia Dist. 4-6000', "common, or at least frequent", *Clarke*; Kohima—Jakpho Mt. 7000', *Clarke*; Centr. Provs. : Pachmarhi, *Duthie*; Bombay Presy.—Mts. of Malabāria (*Clarke* in 'Rev.'), S. Ind., common on the W. Mts. at the higher elevations. S. & W. China; Hongkong. Japan. *Afr.* : Azores, Algeria, Tunis, Abyssinia, Angola; Centr. Afr., Nyassa Land, Zambesi Land. Natal and Cape Colony. Mascaren Islands.

Indian plants of this fern all seem to be small,—well within the dimensions given in the '*Synopsis*,' and copied by Beddome, namely, st. tufted, 12—18 in. l., fr. 2—4 ft. l., 1 ft., or more, broad. It is well known that the European plant grows to much longer dimensions—up to 12 ft. in height.

Baker says—" *O. japonica*, Th. (*O. speciosa*, Wall.) is a curious variety from Japan and the Himalayas, with the fertile and barren fronds often quite distinct, the former being developed the earliest, and soon disappearing. . . . Mr. McKen sends a similar form from Natal." And in the summary of New Ferns, 1891, Mr. Baker says—" *O. japonica* has been gathered in Angola by Mr. H. H. Johnston." Mr. Clarke says—"The common Khasi form is very small, 12--18 in. high; the fertile and barren fronds quite separate: this is *O. japonica*, Thumb.; *O. speciosa*, Wall. But I have collected fronds of this barren below, fertile above." This seems to be the normal, if not the only, form in Japan: I have not seen the rhizome of it.

In Chambā McDonell never got a fertile frond of *O. regalis*. In Jammu and British Garhwāl specimens the fertile and sterile fronds are quite separate. Duthie and Gamble got both kinds of fronds on the same date, in May. Duthie's specimens from Pachmarhi, in the Central Provinces, India, and Gamble's from the Madras Presidency, are typical *O. regalis*, but small.

Sub-Ord. IV.—SCHIZÆACIÆ.

Genus 32. LYGODIUM, Sw.

Sub-genus EULYGODIUM, Veins free.

1. *L. microphyllum*, R. Br. ; *L. scandens*, Sw., Syn. Fil. 437 ; C. R. 588 ; Bedd. H. B. 455.

TRANS-IND. STATES : Baraṇḍ—Ziārat Vy, 5000', General (now Sir Wm.) Gatacre, 1895 : see "Ferns of the Chitral Relief Expedition," Journ. Bot., Vol. XXXIV., No. 379, March 1896.

DISTRIB.—Asia : N. E. Him., Bhotān, Nuttall ; Bengal Plain, rare—Cooch Behar, Sylhet, Chittagong, Clarke. S. Ind.—very common up to 3000'. Ceylon, abundant. Malay Penins. and Isles. S. China. Australia—Queensland. Afr. : Guinea Coast.

The only material from the Trans-Indus States consists of a part of a frond with only sterile pinnae, the shape of which agrees with those of *L. microphyllum*, and they are unlike those of the other species of *Lygodium* which have been found in N.-W. India. Mr. Clarke considers *L. microphyllum* the best marked and least variable species of the genus. It has not before been found in N. India west of Bhotān, Assam, and the plain of N. Bengal. General Gatacre's plant was got in about N. Lat. 35°-25', and E. Long. 71°-50'. Mr. Gamble agrees with me in the identification of this specimen, and says it is an interesting problem in geographical distribution—how this and *Pteris ludens* (see *supra* Vol. XIII, No. 3, p. 457), got into the Chitral Region.

2. *L. pinnatifidum*, Sw. ; Syn. Fil. 438. *L. flexuosum*, Sw., C. R. 584 ; Bedd. H. B. 457. *L. salicifolium* (Presl), Prantl, quoted by Baker in Ann. Bot., Vol. V., No. XVIII.

N.-W. P. : D. D. Dist.—Very common in scrub jungle and forest, 1-3000', Mackinnons, Hope, Duthie, A. Campbell, and Gamble ; Kumāun—2-5000', S. & W., Hope, Davidson, Duthie ; Sajahanpur Dist., near Indalpur, Duthie 1885 ; Gorakhpur Dist.—Ramgarh Forest, 6 miles from Gorakhpur, A. Campbell 1887.

DISTRIB.—Asia : N. E. Ind. (Him.) up to 5000' : Bengal—throughout the Plain, abundant, Clarke ; S. Ind., on both sides of the Madras Presy., common up to about 4000', Beddome. Ceylon. Malaya. Philippines. N. Australia. Afr. : Angola, Guinea Coast.

This fern is common in the Dehra Dún. The fronds from the same root twine together, and if there is a small tree within reach together twine round its trunk to a considerable height. I have measured a plant trailing on the ground, which was 12 ft. in length. The rhizome is small, erect or suberect : stipes approximate, wiry, covered at base with minute black-brown scales : naked above.



3. *L. japonicum*, Sw.; Syn. Fil. 439; C. R. 584; Bedd. H. B. 457.

KASHMIR: *vide* Clarke in 'Review'; Poonch Vy. 3000', Winterbottom; Jhelum Vy. near Domel, "in great profusion," MacLeod 1891, Tawi Vy. 3500', Gammie 1891.

PUNJAB: *Chamba*—Ravi Vy. 4000', McDonell; *Kangra Vy. Dist.*, Mr. D. MacDougall, *vide* Trotter.

N.-W. P.: *D. D. Dist.*—Jaunsar, Tons Vy. 3000', Gamble; The Dún—Vicary in Herb. Hort. Saharapur; Duthie 1882; Johri, near Dehra, 2600', Hope 1889, 1891; *T. Garh.* 3000', Mackinnons 1879; Sahra 7000', Tons Vy. 4000', Gamble; Ganges Vy. 4-5000', several stations, Duthie 1881-83; *Kumaun*, near Banna 5500', S. & W.; 2-5000', many places; "19-7-49, *Hydroglossum*," Herb. Hort. Sahar.; Davidson, Duthie, Hope, Trotter, MacLeod.

DISTRIB.—*Asia*: N. Ind. (Him.) Sikkim and Bhotán 2-7000'. S. Ind.—W. Mts. rare, *Beddome*. Ceylon. Java. Philippines. China—Hongkong. Japan. N. Australia.

Clarke says this plant differs very little, in his opinion, from *L. flexuosum*, and Beddome that it is probably only a form of *L. flexuosum*. Why not *vice versa*? I see marked differences, and do not see the probability suggested. The rhizome is distinctly creeping, though perhaps slowly, and branching; I have not seen *L. pinnatifidum* with that habit.

[ANGIOPTERIS *evecta*, Hoffm. In the Saharanpur Herbarium are two specimens of this, contributed by Dr. King, one of which is ticketed "Hindu Koh," and the other, from the Dalzel Herbarium, "Lahore"; but I think it best not to give this as a N.-W. Indian species. In the '*Synopsis*' is noted, under *Angiopteris*, *Psilodochea salicifolia*, Presl., as "an entirely obscure plant, supposed to have been gathered in Lahore, said to be like *Angiopteris*, but without an involucre." I do not understand Beddome's entry—"Throughout the Indian region up to 7000' elevation." Clarke only says—"Round Bengal, alt. 0-7000', from Nepal to Bhotan and Chittagong."]

1. *O. lusitanicum*, L.; Syn. Fil. 445. *O. vulgatum*, L., var. *Aitchisoni*, C. B. Clarke in 'Review' 586.

AFGHAN: Kurram Dist., "on the shingle plains, at an altitude of 5000'; August", Dr. J. E. T. Aitchison, No. 454, 1880.

PUNJAB: *Rawalwindi* and Hurroo Bridge 2400', Aitch. C. R., and in Herb. Hort. Sahar., 1882; Salt Range—Tilla Mt., and Rhotas, Aitch. 1872-74, in Herb. Hort. Sahar.

Mr. Clarke's description of his *O. vulgatum*, var. *Aitchisoni*, is:—"Rhizome elongate, bearing annually 4-10 fronds in succession, 2-2½ in. l. by ⅔-¾ in. br., oblong, texture stout."

DISTRIB.—Europe: Guernsey: shores of the Mediterranean; S. France—Pau, P. N. Fraser.

Mr. Clarke remarks:—"There is no other *Ophiosglossum* in the Herbarium" (Kew?), "nor any picture much like this: the rhizome appears to bear a

succession of fronds in one season: these are 1—2 fully developed, 1—2 young ones emergent, and several withered laminae on the rhizome." The rhizome is "elongated" upwards, not horizontally. As I find this plant agrees with the figures given in Britten's 'European Ferns' for *O. lusitanicum*, I place it under that species provisionally, though I was at one time minded to make a new species of it—*O. Aitchisoni*. It appears to me quite unlike *O. vulgatum*.

Mr. Clarke remarks:—"A. Braun, in Seuber, Fl. Azorica 17, describes an *O. polyphyllum*; but this has venose fronds, the whole plant only 1—2 in. high, and comes from Terceira, and is probably not near *O. Aitchisoni*." A discussion regarding *O. lusitanicum*, L., and *O. polyphyllum*, A. Br., by H. C. Watson is to be found in "The Azores," by F. du Cane Godman, F.L.S., F.Z.S., &c., and in manuscript "Notes on the plants contained in the collection made by M. Drouet in the Azores in 1857," sent to H. C. Watson by Robert Shuttleworth, Ph. D., of 17th July 1871, which Mr. Baker has shown me, I find as follows:—"89. Although no *Ophioglossum* is in Drouet's collection, I have abundant specimens of the so-called *O. lusitanicum* of the Azores. This has nothing really in common with the true *O. lusitanicum*. I consider it a distinct species from *O. vulgatum* (under two of the forms of which Milde quotes it) for it is apparently widely distributed—Silesia (Milde). I have it from Arabia and elsewhere; and I have received it, or a similar species (which for the present, on account of an apparent midrib—false, probably—I have called *O. Reverchoni*) from the neighbourhood of Briançon (Hautes Alpes) in good specimens, but as being very rare."

2. *O. vulgatum*, L.; Syn. Fil. 445; C. R. 568; Bedd. H. B. 464.

PUNJAB: *Chamba State*—Kantli, 12 miles from Dalhousie 6500', McDonnell 1882; *Simla Reg.*—Hattu Mt. 8-9000', Dr. G. Watt 1885 (Blanford in List); Bagi (Hattu Mt. ?) 9400', Bliss 1891-92.

N.-W. P.: *D. D. Dist.*—Jaunsar, Thadyar 7000', Rogers 1891, Bedyar 8000 Gamble 1894, Kathián 7000', Gamble 1895; Mussooree—'The Park,' above 6000', Mackinnons 1885, Hope—seen July 1892—too late in the season—station shown to me by V. Mackinnon; in the Dún—Kalanga Hill, near Dehra, 8000', Gamble 1894.

DISTRIB.—*N. Amer.*: Quebec and Ontario southward to Florida and California; Kentucky, Tennessee, Texas and Arizona to Alaska. *Europe*: Lapland, British Isles and almost all other countries to Caucasasia. *Asia*: N. Ind. (Him.) Sikkim 2-4000', Anderson, Clarke, Levinge; Bengal—Chutia Nagpur, on Para náth Mt. 2500', Clarke Nos. 33823 and 33826. Japan, Sandwich Islands, Australia, N. Zealand. *Afr.*: Azores, Abyssinia, Guinea Coast, Angola, St. Helena, Zambesi Land, Cape Colony, Mascaren Isles.

I cannot make out the difference between *O. vulgatum*, L., and *O. reticulatum*, L., unless it be that the net-work of veins is fine all over the frond in the latter

named species, and in the former five only near the margins, the meshes in the centre being long and narrow. Anyhow, I can see no difference between the N.-W. Indian specimens and those I have gathered in Scotland, except that one of Gamble's plants from Jaunsar and another of his from Kalanga Hill in the Dún, both in my possession, have two fronds, one of them sterile. So also has a specimen collected by Dr. King, in the Teesta Valley, Sikkim, in 1876. B. ddome, in Suppt. H. B., 1892, says he believes "all the Himalayan specimens are referable to *reticulatum* ; I can see no difference in the venation." Why, then, does he favour *O. reticulatum* ?

#### Genus 34. BOTRYCHIUM, Sw.

1. *B. lunaria*, Sw. ; Syn. Fil. 447 ; C. R. 587 ; Bedd. H. B. 469.

AFGHAN : Kurram Vy., Ghend Toi "profuse", 9-10,000', Aitch. 1879.

KASHMIR : West of Gulmarg, 9000', Aitch.

PUNJAB : Simla Reg.—Hattu Mt. 8-9000', Kamalhari Mt. 9-10,000', Dr. G. Watt 1885, *fid.* Blanford.

N.-W. P. : *T. Garhwal*—Nag Tibba Mt. 9-10,000', W. Gollan 1881 ; Damda Vy. 10-11,000', Duthie 1888 ; *Kumaun* above Tola 12,000', S. & W. ; Gaibyang 12,000', Duthie. Also—N.-W. India, Jameson, *fid.* Clarke in 'Review.'

DISTRIB.—*N. Amer.* : Greenland, Newfoundland, Canada, British Columbia ; *U. S.* : New York, Lake Superior, Colorado. *S. Amer.*—Patagonia. *Europe* : Iceland, Arctic Russia, Livonia, Lithuania, and Caucasia ; British Isles ; Spain, Italy, Switzerland and Mediterranean Isles. *Asia* : W. Thibet, Falconer : Karakoran Range, 12,500', *Clarke* ; N. Ind. (Him.) Sikkim—Lachen 10-13,000', Hk. fil. Kamschatka, Japan. Australasia—S. Australia, Tasmania, N. Zealand.

2. *B. ternatum* (Thunb.) Sw. ; Syn. Fil. 448 ; Bedd. H. B. 110.

PUNJAB : *Chanba*—McDonell ; *Simla Reg.*—Simla, "a little below 7000'," Blanford ; Summer Hill, Collett, Chadwick Falls 6000', Bliss, "The Waterfalls," Bliss ; Mashobra 75-8000', Bliss, Watt.

N.-W. P. : *D. D. Dist.*—Jaunsar, Bodyar, Mrs. Sladen 1880 ; Mussooree, 10-7-45, in Herb. Hort. Sahar., under *B. daucifolium* ; 'The Park', 6200', Mackinnons 1885 ; *Kumaun*—Naini Tál, Levinge : *fid.* Bedd. in Suppt. H. B., Bhim Tal, W. Ainslie, in Herb. Levinge.

DISTRIB.—*N. Amer.* : Nootka and Hudson's Bay Territory, Canada ; *U. S.* : New England, westward to California, Washington, and southward to Florida. *S. Amer.* : New Grenada. *Europe* : Lapland, Spain (Pyrenees), Hungary. *Asia* : Siberia, Kamschatka, Japan ; N. Ind. (Him.) Nepal, *Wallich* No. 49, Sikkim—*Clarke*, *Levinge* ; *Centr. Ind.* : Mt. Abu, Sir M. Grant Duff. *Australasia*—Tasmania, N. Zealand.

Indian specimens of this form used always to be ticketed *B. daucifolium*, Wall. But I saw in Mr. Gamble's collection a specimen of Mr. Clarke's, got in Assam in 1886, No. 45827, named *B. daucifolium*, which seemed to me to be typical, and quite different from those others. About the same time Mr. Trotter told me that Mr. Bliss thought the Simla fern was not *daucifolium*, and on hearing that I also had doubted this, Mr. Bliss wrote—"I am very pleased to find



that, at last, some one besides myself has discovered that our Mashobra (*Simla*) *Botrychium* is not *B. daucifolium*."

[Beddome, in his Handbook, gives *B. daucifolium*, Wall., as found "throughout the Indian region, up to 8000' elevation;" but the only specimen in the Kew Herbarium from the westward of Nepál so named is one marked Kumaun, R. Bl. 49, "*an mera varietas*, Wall. 48?" But No. 48 of Walliche's catalogue is *B. lanuginosum*, Wall.

The other habitats of *B. daucifolium*, to which the specimens in the Kew Herbarium are referred, are Nepál, Winterbottom; Sikkim; Bhotán Griffith; Nilgiris, Beddome and Clarke; Anamalais, Beddome. Ceylon, Gardner. China—Yunnan, Henry. Japan. Samoa.]

McDonell's specimen of *ternatum* from Chamba is curious; it has two sterile segments at the base,—the fertile branch starting  $1\frac{1}{2}$  in. up. A Mussooree specimen I have from the Messrs. Mackinnon, shows the sterile and fertile branches on segments splitting from a common stipes at barely half an inch from the root stock,—the sterile one 7 in. l. by  $7\frac{3}{4}$  in. broad, as mounted. The fertile branch has a stipes  $10\frac{1}{2}$  in. l.,  $\frac{5}{16}$  —  $\frac{7}{16}$  inch broad, as pressed; frond over 6 in. l. tripinnate. Mr. Ainslie's specimen from Kumaun, in the Levinge collection in Dublin, I noted as being very lax in habit: sterile branch  $13\frac{1}{2}$  in. l. from the point of separation: fertile branch 24 in. l., much branching. In the same collection I noted a remarkable specimen collected by Mr. Levinge in Darjiling, alt. 7160', 12-10-1882, of which the fertile branch starts at 3 inches from the rhizome: the sterile spike (or the frond) then curves to the right (as mounted), and  $\frac{3}{4}$  in. higher up throws off to the left a fertile branch with a thick stipes, which  $1\frac{1}{2}$  inches higher splits into two fertile, branching, segments of equal length. I believe Professor L. M. Underwood says that what I call *B. ternatum* is *B. obliquum*, Muhl.

3. *B. virginianum*, Sw.; Syn. Fil. 448; C. R. 588, including *B. lanuginosum*, Wall.; Bedd. H. B. 471, including *B. lanuginosum*, Wall.

PUNJAB: *Hazdra Dist.*—Kagán Vy. 8000', Inayat, collector from Hort. Sahar. No. 20388 (Herb. Number); *Chamba State*—McDonell.

N.-W. P.: *T. Garh.*, Datuni 7000', Gamble 1893, No. 24348; Muráli 8000', Gamble 1894, 24886; Duthie 1898.

DISTRIB.—*N. Amer.*: New Brunswick to Florida, and westward to Arizona and the Pacific Coast, *vide* Underwood. *S. Amer.* Ecuador and Brazil,—*vide* 'Synopsis'. *Europe*: from Norway to Austria. *Asia*: N. Ind. (Him.) Sikkim—Rungbee, King 1878; marked "abnormal form."

I give this species as new to India, because I have no distinct recollection of King's Sikkim specimen, noted above: and, besides, that specimen has not been recorded. While I was at the Royal Herbarium, Kew, in 1888 or 1889, along

with Mr. McDonell, I detected the Chamba specimen in his possession; and since then a few other specimens have turned up. Instead of making this a variety of the common Indian fern, *B. lanuginosum*, Wall., I bow to authority, and give it as *B. virginicum*, Sw., because the fertile segment of the frond separates just below the base of the sterile part, and the cutting is sharper than in *B. lanuginosum*, and the texture is not woolly. It is one of the rarest of Indian ferns.

Now, in finally revising this article, and having had the advantage of studying well authenticated specimens of the American plant, I am all the more satisfied that it is quite distinct from Wallich's *B. lanuginosum*; but I am not so sure as I was that the above noted Indian specimens are the same as the American plant. More material is desirable.

4. *B. lanuginosum*, Wall. Cat. 48. *B. virginianum*, Sw., *β.*, *B. lanuginosum*, Wall. Syn. Fil. 448; *B. virginianum*, Sw., C. R. 588 (*B. lanuginosum*, Wall., given as a synonym.) *B. virginianum*, L. (under *Osmunda*), var. *B. lanuginosum*, (sp.), Wall. Cat. 48, Bedd. H. B. 471.

PUNJAB: *Chamba State*—McDonell, in List: *Simla Reg.*—Simla: not uncommon, Hope, Blanford, Trotter, Bliss.

N.-W. P.: *D. D. Dist.*, Mussooree, in various places, 45-7000', Duthie, Mackinons, Hope, A. Campbell; *T. Garh.*—Jumna Vy. 6-7000', Duthie near Sainjni, 5000', Gamble 1898; *Kumaun*: Wallich; Gajur Pass, Davidson; Naini Tal 6000', Hope 1861; Almora 5-5500', Madden, S. & W., 1848, Hope 1861; between Daudiháth and Karéla 5-6000', Duthie 1884; 6-8000, "common", MacLeod 1893.

DISTRIB.—*Asia*: N. Ind. (Him.) Nepal, Wallich; Sikkim and Bhotán common, Clarke; Assam—Khásia Dist., 4-6000, very common, Clarke; Manipur 5500'. S. Ind.—at the higher elevations on the W. Mts. Ceylon—above Newera Elya, China—Yunnan and Hupeh Henry; Yunnan Hancock.

The distinctions between *B. virginianum* and *B. lanuginosum* are thus stated by Beddome:—"In the typical American plant the fertile branch arises from the base of the sterile portion, and the latter is quite glabrous: in the Indian plant the fertile branch always springs from well above the base, and the sterile portion is more or less hairy." These two distinctions being, with rare exceptions, coincident, are corroborative evidence of permanent and, I should say, specific differences. I see a few soft hairs on some specimens of *B. virginianum*, but nothing amounting to wooliness.

Clarke refers to Milde's monogram on *Botrychium*, and to his Fil. Europe, 191-209, in which that author divides the genus into two main sections, viz., (1) Cells of the epidermis straight: (2) Cells of the epidermis flexuose; secondary pinnæ of the lowest pair of pinnæ anadromous; and he (Clarke) says that the second section contains *B. virginianum* (the American type plant only); the first section comprising, among other species, *B. lanuginosum*, Wall., which Milde and Prantl both hold to be a good species.

one character being the catadromous secondary pinnæ at base of a sterile segment. Clarke finds that all the Indian material he has seen seems one species, with straight epidermis cells; but he can make very little of the anacata-dromous distinction. Milde finds both sets of plants in the Himalaya, and reckons them very distinct species. After examining all the specimens of *B. lanuginosum* in Gamble's and my collections, I find that a decided majority is catadromous, but one specimen is anadromous on one side, and has pinnules exactly opposite each other on the other side. I think with Clarke that this distinction may be disregarded,—the more so that it is not needed.

*B. lanuginosum* varies very much in size, cutting, and habit. I have a specimen from a little below Naini Tál with stipes 4 in. and frond 5 in. l. by 6 in. br., and another from the hill north of Almora, grown in open pasture—mounted on two sheets, though minus the upper third—the lower pinnæ of which are 10—11 in. l. by 6—9 in. br., as mounted. The next higher pair of pinnæ are  $7\frac{3}{4}$  and 9 in. l. by  $3\frac{1}{2}$  in. br. The fertile spike is about 8 in. l. with lowest pinnæ  $3\frac{1}{2}$  in. l., tripinnate like the rest of the frond. A large frond, also from Kumaun, *Davidson*, is much more compound, and may almost be said to be quinquepinnate. I look upon the sterile part of the plant, taken together with the stipes, as the frond, and would not talk of it as a segment. It is a regularly pinnate frond, and the fertile spike is an extra branch or pinna, which does not interfere with the symmetry of the frond in other respects. I am confirmed in this view of the structure of the plant by finding in Gamble's collection a specimen from Ootacamund, in the Nilgiris, which, besides the usual fertile pinna (in this case as in all Mr. Gamble's Nilgiri specimens, taking off above the second lowest pair of the frond), has a small fertile pinnule on one of the lower pair of pinnæ taking off above the lowest pair of secondary pinnæ or pinnules. Another curious specimen in Gamble's collection from Mysore 5000', "coll. W. A. Talbot," No. 3087, 1893, has two fronds springing together from the same root, about equal in size, and perfectly normal, each with its fertile spike. My large specimen from near Almora has some sori on the sterile pinnæ, one cluster of six on the fourth pinna from the base, and several others here and there. I think a similar case was mentioned lately in the Journal of Botany with regard to another species of *Botrychium*. *B. lanuginosum* has a thick rhizome and thick, fleshy roots, and is a terrestrial fern; but, like various other plants of the Himalayan forests, it is sometimes found growing in the clefts of branches of trees, sometimes high up. I have two specimens from Assam which are quite glabrous.





## THE FERNS OF NORTH-WESTERN INDIA.

Including AFGHANISTAN, the TRANS-INDUS PROTECTED STATES, and KASHMIR: arranged and named on the basis of Hooker and Baker's *Synopsis Filicum*, and other works, with New Species added

By C. W. WOPE.

(Continued from page 111 of this Volume.)

## AFTER-WORDS.

I regret that the publication of this paper has extended over a much longer period than I anticipated: but I now recognise that this is due to the method of publication I was constrained to adopt, and somewhat, perhaps, owing to miscalculation on my part. The *Journal of the Bombay Natural History Society* has to deal with various branches of Natural History beside Botany, and the tastes of the members tend to the study of Zoology rather than to that of Botany. And I must admit that Ferns do not present the economic interest that some other branches of Botany do.

2. Parts II and III.—“New Species,” and “The General List,” were written in India before 1896; but they have been revised from time to time, as further material turned up, and as views came to be modified. Part I, Introductory, was written before the rest of the paper was sent to press, and a glance at it may now be taken to see how the scheme has been realised

3. Mr. Duthie, the late Director of the Botanical Department, Northern India, continued to send me duplicates of specimens got by himself or his native collectors, and also of many contributed to the Saharanpur Herbarium by Mr. James Marten, of the Indian Forest Survey Department, collected by himself in the Chamba State, chiefly at high altitudes. Mr. Marten is a very careful collector, and his specimens are beautifully preserved. They include several rarities. Mr. Gamble also has given me many specimens collected by himself in the Jaunsar tract of the Himalaya, and by Mrs. Fisher in British Garhwál, from which latter-named district also, from low altitudes, several interesting species were brought by Inayat, one of the Saharanpur collectors, in 1902, including *Nephrodium calcaratum*, Hook., and *Acrostichum crispatum*, Wall. The first-named of these species had been got in N.-W. India only twice before, more than 30 years ago, and the second only in West Nepal, just outside the boundary with Kumaon. It is the only *Acrostichum* in North-Western India.

4. No new books or papers on Indian Ferns have appeared, that I know of, since Part I of this paper was written ; but as two or three years before the late Sir Henry Collett's "Flora of Simla" was published I had given him a completer list than he had of the Ferns of his Simla Region, and as I found he had not dealt with the Ferns, as being beyond the scope of his "Flora," though he had hoped to do so in a separate work, I showed the list to Mr. W. Botting Hemsley, who, after Sir Henry Collett's death, was seeing his book through the press, and in his Introduction he gave the list (not here reproduced) with the following mention of the subject :—

"THE FERNS OF SIMLA."

"The Ferns of Simla are so numerous that the late Sir Henry Collett never intended to include them in the present work, but he contemplated publishing an account of them in a separate volume. He collected material for this purpose, and I have before me a list of seventy-one species collected by him in one season. As may be seen from the Bibliography at p. lxvii, several other persons have made a special study of this class of plants, and Colonel Beddome's Handbook may be mentioned as the best available work for naming the Ferns of Simla. Although descriptions could not be given, I have considered it desirable to append a complete list of the species hitherto discovered in the District of Simla. I am indebted to Mr. C. W. Hope for this list, and I present it entirely on his authority. In addition to his own very rich collection, it embodies the results of several collectors whose names are not mentioned in connection with the flowering plants. Among them are General Blair, Mr. T. Bliss, Mr. E. W. Trotter, and the late Mr. H. F. Blandford, F.R.S.

[HERE FOLLOWS THE LIST.]

"This gives a total of 124 species belonging to twenty-three genera, as against sixteen genera and thirty-seven species in the British Islands, and twenty-seven species in the county of Sussex, which has a larger area than Simla, as here understood—a rich fern flora indeed ! With the exception of the *Gramineae* (133 species) ferns are more numerous than any Natural Order of flowering plants in the Flora of Simla."

5. In the Introduction I said that my list admitted 212 species, 16 of them being new. In the course of revision one species has dropped out and the number is now 211. The number of new species has fallen



to 15, as shown in Abstract I of the List, given above, p. 428. These new species are illustrated by 14 Plates. Besides these 15, 8 species are given in Abstract II as new to British India, and 26 species are new to the limits with which this work deals. In all 35 Plates have been given.

6. I have adhered to my resolution to give no place in my list to so-called varieties, but—when distinct enough from the so-called types to be separately described, and constant in character—to give them as species. I have, however, struck out from the list of species *Asplenium dentigerum*, Wall., and have given it as a “form” of *A. Filix-femina*, Bernh. (not *F. foemina*—as often, and in my Introduction, printed), because it varies so much in cutting, (as I came to see) that it is difficult to select any specimen of it as a type: all have a strong resemblance to *A. Filix-femina*, though there is a difference from it. Moreover, since Clarke and Beddome last wrote, typical *A. F.-femina* has been found, in 1891 and 1892, growing in several localities in Kashmir; and specimens of older date in the Kew and Saharanpur Herbariums have been recognised as typical *F.-femina*. But as typical specimens of the species have been found distributed, though sparsely, over N.-W. India, in the Himalaya, the presence of a form of it in our region is the more easily accounted for. The same change in the position of *Nephrodium Filix-mas*, as a British India fern, has happened. The researches of Harris, Trotter, McDonell, MacLeod, and Duthie have shown that the type of this species is not uncommon from Baraul eastward to the South-West of Kashmir, and that it is to be got in Chamba; and earlier specimens have been recognised as typical.

7. The figures in Plates XXVII and XXVIII will, I hope, be found to justify me in breaking up the species *Aspidium* (Polyst.) *auriculatum* into four,—it being so far as is known exinvolucrate, (or abinvolucrate) and never found in Northern India, and the other three, placed by recent pteridologists as varieties of it, being abundantly different in cutting and venation. The development of cutting, from that shown in fig. 1 of Plate XXVII to that of figs. 3 and 4, is remarkable. The broad and deeply cut form I and others had for years sorted into quite a different species, namely, *Aspidium* (Polyst.) *aculeatum*, Sw. But the venation and clothing on the under surface of the fronds—of very minute scales—seem to leave no doubt on the subject.

8. The group of *Aspidium*, hitherto placed as *A. (Polyst.) aculeatum*, Sw., and varieties, Nos. 113 to 116 of my list, cannot stand. There appears, indeed, to be no good ground for maintaining the name *A. aculeatum* any longer; and it is, in my opinion, inapplicable to any Indian plant. Continental botanists seem to use the specific name "*lobatum*" instead of "*aculeatum*"; and "*squarrosus*," Dou, is an older name than "*rufo-barbatum*," Wall., for the common coriaceous shiny Indian plant. I have used the specific name "*angulare*" for the softer plants, of several different forms, which at one time I thought of setting up as *A. molle* n. sp. One of them is very near *A. angulare*, but generally with different clothing on the stipes and rhachis. The fronds of this form vary from about 1 foot to 3 feet in length, and the width sometimes exceeds 2 feet, with pinnules deeply cut into as many as ten segments. This is what Dr. Christ, in "*Filicinae*, Warburg, Mon-sunia," calls *A. angulare*, var. *batjanensis*; but in the Dehra Dun and the Mussooree Himalaya plants of all sizes from 1 foot to 5 feet high are to be got, the length and number of segments of the pinnules increasing with the size of the plant.

9. In no case have I seen any reason to unite with the type any of the so-called varieties of *Nephrodium (Lastrea) Filix-mas.*; but I have put some of the less divergent forms under *N. parallelogrammum* Kunze. *Nephrodium odontoloma* (Moore), Bedd., (*N. F.-mas*, var. *2 normalis*, C. B. Clarké), I now believe, after seeing many more specimens from the Punjab and elsewhere, to be the same as *N. pallidum*, Bory, of South-Eastern Europe and Western Asia, of which Mr. Gustav Mann was kind enough to get me authentic specimens. I have always held that this plant is quite distinct from *N. rigidum*, Desv., Mr. Clarke's No. 18, p. 323 of 'his Review.' *N. rigidum*, Desv., for which he gives as a synonym *N. pallidum*, Bory, seems to be certainly this plant. And nothing has turned up which makes me more inclined to admit any connection of *N. marginatum*, Wall. (under *Aspidium*) with *N. elongatum*, H. and Gr., or any form of *N. F.-mas*.

10. *Nephrodium prolixum*, Baker, which, reviving an old name of Willdenow's, seems to have been designed to include Kunze's two species—*N. ochthodes* and *N. tyloides* (this latter name should be *xyloides*, but Kunze himself originated the misprint), I have resolved into its original constituents; and as I found that the plant of the North-Western Himalaya, which had been called *N. ochthodes*, or *N. prolixum*,

always has a markedly creeping and branching rhizome, I have separated it as a new species—*N. repens*, Hope. An exactly similar character has led to the separation of *Polypodium* (*Phegopteris*) *late-repens* (Trotter), Hope, from *P. (Pheg.) distans*, Don. These two instances show the importance of ascertaining and recording the nature of the rhizome of a fern.

11. I have heard nothing but praise of the Plates by which the paper is illustrated. Owing to pressure of other work, Mr. N. E. Brown had to give up his co-operation, but fortunately I was able to get that of Mr. J. N. Fitch, a well-known artist, who had already figured many ferns, and he has very zealously and skilfully carried out my wishes. The work in Calcutta—the completion of the drawings where enlargement was not required, and lithographing the plates—has given great satisfaction ; latterly it has been very kindly superintended by Lieutenant A. T. Gage, I. M. D., who succeeded Dr. Prain as Curator of the Calcutta Herbarium.





## THE FERNS OF NORTH-WESTERN INDIA.

Including Afghanistan, the Trans-Indus Protected States, and Kashmir : arranged and named on the basis of Hooker and Baker's *Synopsis Filicum*, and other works, with New Species added.

By C. W. HOPE

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